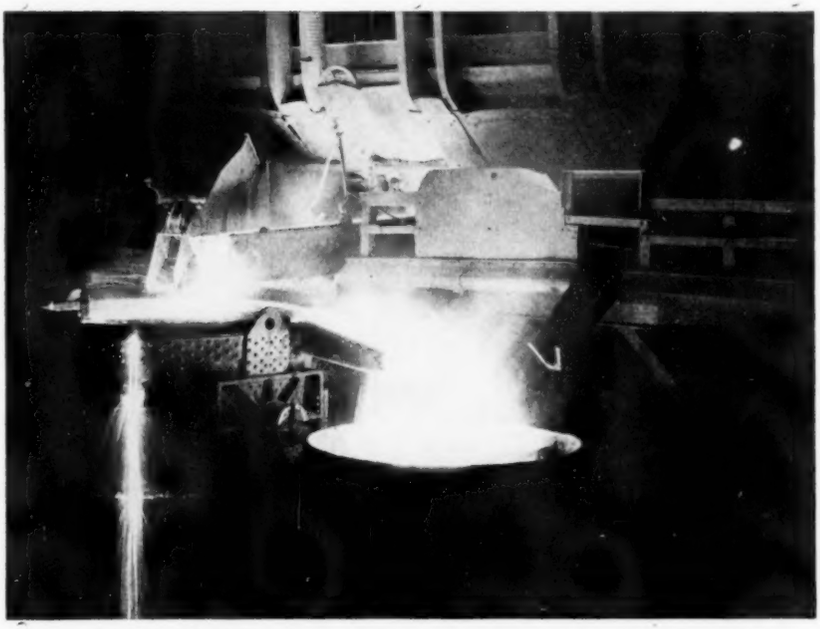
What's in This Issue



The National Metal Exposition will focus attention on steel and equipment for working it. The "Show-In-Print" is on page 86.

What are the properties of stainless steels? If your shop does any work in stainless, you will be interested in the comprehensive data on pages 874–875 which can be used as a guide.

Just **what happens in the cutting of metal when an automatic lathe goes into action** has been caught with a high-speed camera by the research and development division of Jones & Laughlin. The results are told, together with the pictures themselves, by Y. J. Bruce, Jones & Laughlin metallurgical engineer, on pages 886–887.

You have read about English shadow plants in *American Machinist*. John W. Rix, production engineer of Waco Aircraft, **doesn't think the idea of shadow plants is so hot** and tells why on page 894.

Whether you go to the National Metal Exposition or not, you will be interested in the latest equipment to be shown there. Description of the equipment starts on page 861 in our "**Show in print**" **section**. There are plenty of illustrations.

Plating to accurate limits isn't an easy job. The proper finishing of small parts depends on automatic current-density control and on careful maintenance of the plating solution. Turn to page 881 to get a **complete account of plating practice at Westinghouse's meter division.**

Welding of stainless steel is an art which is rapidly striding ahead. T. R. Lichtenwalter of Republic Steel brings you up-to-date on this subject on page 877.

Carburizing as a case-hardening process has come along at a fast pace, but great possibilities for further development are still ahead. Walter F. Hedrich of Surface Combustion reviews the situation (page 890).

To get a fast braze in a thin shell is a problem that requires a lot of experimenting before it is licked. One company tackled the problem successfully by using a low melting-point silver alloy. Details of how it was done are on page 888.

Welding has become a "state of mind" in some plants. R. G. LeTourneau is one of these plants. On page 893 is the story of **how LeTourneau joins tractors parts by electric arc welding.**

What is the foreman's primary job? L. A. Appley of Socony-Vacuum Oil thinks that it has been taken away from him and should be restored. Read what he has to say on page 909.

If you have to **heat-treat straight chromium stainless steels,** you will want the information on page 880 to help you.

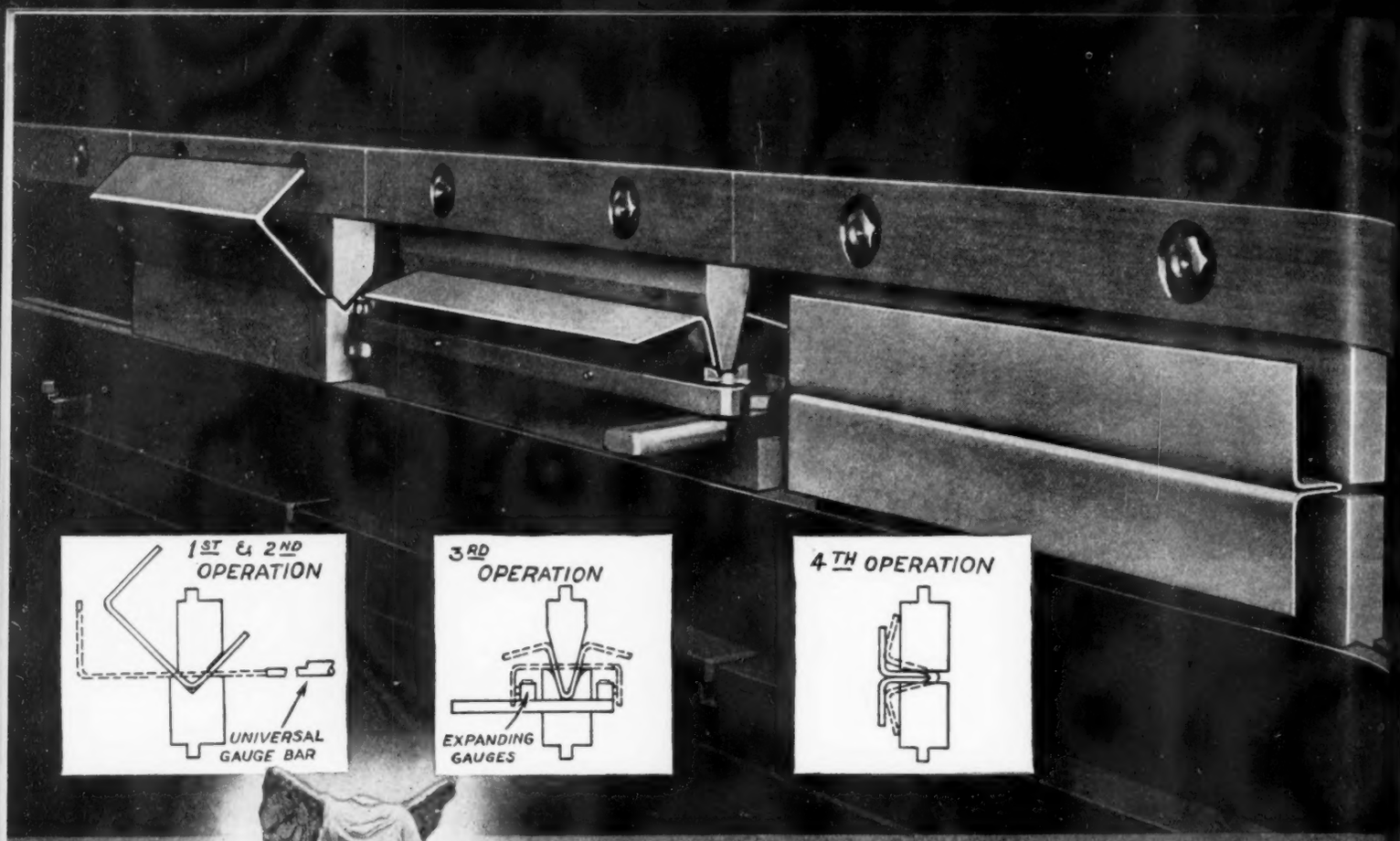
Malleable iron has pushed ahead recently because of developments in the casting art. Read about the **practical uses of malleable** on page 913.

COMING

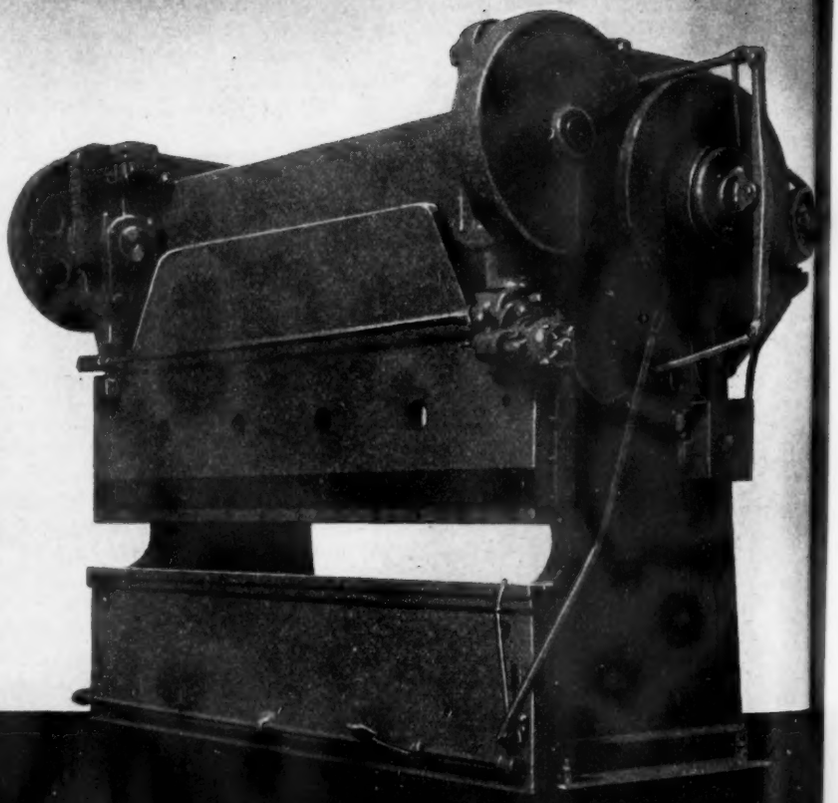
Stamping of automotive parts requires great care in the selection of the proper steels. Specifications of such steels are much fussier than they used to be and more skill is needed in producing these steels. Treatment of the steel within the fabricator's plant takes more attention, too. All of this is brought to a head in a leading article in the next issue dealing with the practices in the Philadelphia plant of the Edward G. Budd Mfg. Co. You shouldn't miss this story.

Public relations was the subject of a 24-page insert in our issue of September 21. That was only the beginning of our editorial treatment of that subject. There will be more—a great deal of it—in the next issue. You will learn how much is being spent for equipment for the safety and comfort of employees, based on a survey of the practices of 90 companies. There also will be an article giving the answers to leading questions on which public thinking has been "fuzzy."

Like every other issue of *American Machinist*, the next issue will be packed with information which the production shop executive can use. Among the list of articles will be one on short cuts for the small shop and another on seven ways to finish a crank.



Progressive forming accomplishes on one machine what otherwise would require several brakes or separate set-ups on the same brake • • • Cincinnati Press Brakes form each bend accurately, even with a different pressure on each die. • • • • • • • • • • • • •



THE CINCINNATI SHAPER COMPANY
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SHAPERS • SHEARS • BRAKES

AMERICAN MACHINIST

ESTABLISHED 1877

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BURNHAM FINNEY, Editor

Nor Do These Couriers Pause

DO YOU RECALL that impressive message carved in bold letters across the front of many postoffices, "Neither snow nor rain nor heat nor gloom of night stays these couriers from the swift completion of their appointed rounds"? That is the proud claim of the United States Postoffice Department which seeks to uphold it under whatever conditions may be imposed.

Some similar message might well be penned on behalf of the men who have worked through the years to keep American industry abreast of the latest scientific developments. The results of their labors will be on display at the annual exhibition and meeting of the American Society for Metals in Detroit the week of October 16. It is to the description of the latest processes developed by these specialists that this issue of *American Machinist* is devoted editorially.

Prospects of war, the New Deal, problems affecting the relationship of management, labor and the public, and readjustment of industry to the times have kept management so occupied in recent months that the continuing contributions of science to the technique of manufacture have not been accorded the recognition deserved. Yet the progress made in such production processes as heat-treating, welding, stamping and finishing of steel is little short of amazing.

How have these technical developments helped the consumer? Well, that isn't hard to figure out. Take a present-day automobile and compare it with a car ten years old. The 1938 car is sheathed in steel from bumper to bumper and from top to underframe and wheels. That has been made possible by notable strides in the art of deep drawing of sheet steel and by production of sheets of extraordinary width on continuous mills. The 1938 car has a lacquer or enamel finish which is applied in a fraction of the time formerly required, yet is far more durable than the older finishes.

The 1938 car has engine tolerances so fine that performance is more powerful, smoother and of greater durability. Weight savings have been made by the use of light alloy steels, but at the same time strength of parts has been increased. Welding has done its share in making possible the application of new designs and in hastening the day of all-steel bodies. Stainless steels and the spraying of sheet steel parts with rust-preventives have prolonged the life of car finishes.

One might go on for pages piling up the evidence to show what technical advances have done for the automobile owner. And the evidence could be extended from automobiles to electric refrigerators, to trolley cars, to vacuum cleaners, to radios, and to dozens of other articles which all of us make use of in our daily lives.

What do these developments mean to the manufacturer? They enable him to produce better goods, to find a way whereby he can turn out a better product than his competitor, and usually, in the end to lower his costs. These are worthy objectives which also benefit the consumer.

THESE advances in technology have come because American industry has had the courage and good sense to continue expenditures for research and development work through bad times as well as good. Inquiry reveals that companies with ample financial resources intensify their research activities when depression begins to pinch.

So it is fitting that thousands of metallurgists, engineers and production executives should make a pilgrimage to the A.S.M. meeting and exhibition at Detroit this month. Governments change and political and social ideas shift, but the onward march of technical progress in American manufacturing industries is never-ending.

Gaging Business

WITH the European war scare ended, the metal-working industry is looking ahead with restrained optimism to the fourth quarter. Machinery builders continue mainly dependent on export orders to keep factories operating well, but a steadily growing volume of business is coming from domestic sources, particularly from the Federal government.

The War Department, for example, has recently allocated $15,000,000 to manufacturers for anti-aircraft guns and other ordnance equipment and will award $10,000,000 more in the next two to three weeks. Automobile makers and parts companies are expanding output on 1939 models, with the industry hopeful that retail car sales this quarter will be large. Railroad shops have taken back many employees recently to do repair work, but rail and other equipment buying by railroads is likely to be small. Steel production, spurred partly by automotive releases, is expected to rise considerably above 50 per cent during the next month. Tractor demand is better. Sales of washing machines and ironers showed a sensational rise in August over July, and the September volume is believed to have shown a further gain.

NEW ENGLAND—Materials for reconstruction of buildings, roads, pole lines, small bridges, sections of railroads and other property destroyed in the hurricane and floods are pouring into this district. About one-fifth of all motors in storm-damaged textile mills need to be scrapped, according to reliable estimates. Repair shops are working 24 hours a day reconditioning motors and other electrical equipment. Large replacement sales of passenger cars and trucks are expected. Small tool orders have been hit temporarily, but outlook for heavy machine tool sales to shipyards and arsenals is excellent.

PHILADELPHIA—Improvement in machinery bookings is traced mostly to government awards. Private buyers are holding to a watchful waiting policy without much indication of a change in attitude in the near future.

NEW YORK—September machinery sales are reported by dealers to have shown an increase over August. Government purchases have helped keep sales up.

PITTSBURGH—After a temporary setback attributed to war developments in Europe, the steel rate, now ranging between 45-50 per cent, is expected to advance well above 50 per cent in the next month. Chief support is looked for from the auto industry, which already is buying steel more freely. Miscellaneous steel users have bought considerable tonnage. With prices stabilized at current levels, however, there is little urge to stock ahead.

CLEVELAND—The war tension has slowed down machine tool bookings and has adversely affected steel releases. Auto parts factories are pushing up their operations. The steel rate promises to advance this month.

DETROIT—Sales of perishable tools are increasing as auto makers get into production. Customers' stocks are low, and many plants are getting along with reworked tools. With Ford and Ford suppliers expanding operations this week, the outlook for further gains is good.

TOLEDO—Local manufacturers are confident of an upturn now that the war scare is over. Inquiries for heat-treating furnaces are lively. Auto companies have recently placed orders for standard machine tools and other machinery of an automatic nature.

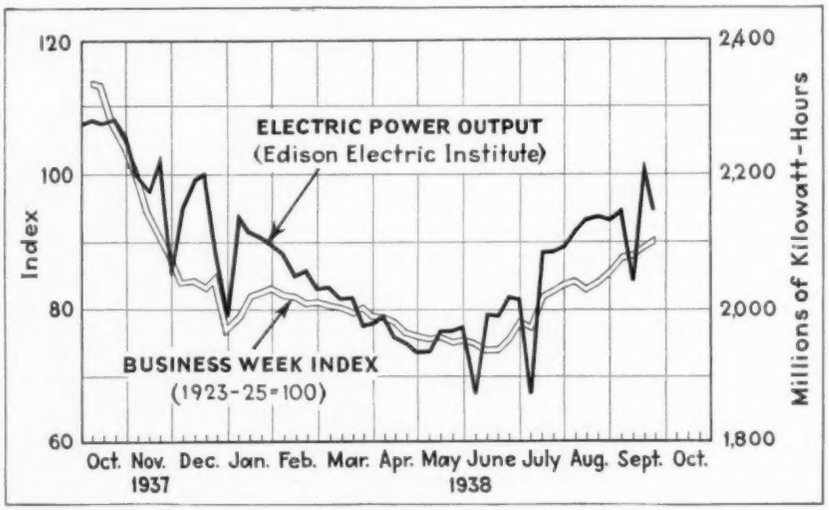
CHICAGO — Business continues spotty. Steel output is staying at recent level of 41 per cent with miscellaneous users being the most influential factor. Tractor sales, especially for industrial purposes, are looking up. International Harvester will recall 6,500 employees at its Chicago, Milwaukee and Rock Island plants during next few weeks. Leading stoker makers are working at full capacity. Rockford equipment builders report a slow but steady improvement since early in August. Closing of Nash factories at Kenosha and Racine has caused considerable distress in both of these communities.

CINCINNATI—Biggest stimulus to machine tool orders has continued to come from foreign buyers, though the war department has placed a small amount of business locally. Domestic sales are still anemic. Die shops at Dayton are reported doing a fairly steady business.

SAN FRANCISCO—Aircraft companies continue to produce at capacity and still have the largest backlogs in their history. Machinery buying has been slow.

POWER OUTPUT VS. GENERAL BUSINESS

The steadily increasing consumption of electric power, leading rather than lagging behind the index of business activity, presages a further improvement in general conditions



G. B. WATERHOUSE, of the Massachusetts Institute of Technology, has presided over the A.S.M. since fall of the past year

W. P. WOODSIDE, in charge of research for Climax Molybdenum Company and vice-president of the A. S. M., will soon assume the office of president to serve during the next year

J. P. GILL, of Vanadium Alloys Steel Corporation, has been chosen to take MR. WOODSIDE'S place as vice-president of the A.S.M

M. A. GROSSMAN, who will discuss the relation of hardenability to quenching, represents the Carnegie-Illinois Steel Corporation

A. H. D'ARCAMBAL, with W. E. BANCROFT, will represent PRATT & WHITNEY with a lecture on the machinability of tool steel

R. B. SOSMAN, of the U. S. Steel Corporation research laboratories, will conduct a series of educational lectures on pyrometry

HANS ERNST, research department director, Cincinnati Milling Machine Company, will deliver an educational lecture on the physics of cutting

Many to Speak at Metal Congress

METALS have long since come into their own as materials of construction and machine fabrication. Once a year they become the major topic of the many men attending the National Metal Congress.

Metallurgists, metal makers and metal users will gather this year at Detroit during the week of October 17 to compare notes on their findings in the laboratory and shop. Their exchange of ideas will eventually materialize in new uses of metal and better methods of processing them. With space already reserved for over 230 exhibitors at the Metal Exposition which forms part of the Congress, "Metal Week" seems predestined for success. One estimate is that some 10,000 persons will attend.

Sponsoring the Metal Congress are the American Society for Metals, The American Welding Society, the American Institute of Mining and Metallurgical Engineers and the Wire Association. All of these organizations have arranged comprehensive programs including meetings, banquets, technical sessions and trips through nearby industrial plants.

Outstanding among the activities for the week are the plans made by the American Society for Metals. With headquarters at the Statler Hotel, this association has scheduled eighteen technical sessions in addition to the annual meeting and other regular activities of the organization. At this meeting of the society, officers for the coming year will be installed. W. P. Woodside, for the past year vice-president of the organization,

P. G. LANG, JR., has served the past year as the president of the A.W.S. As engineer of bridges for the Baltimore & Ohio Railroad, he has been active in adapting fusion welding to structural applications

H. C. BOARDMAN will head the A.W.S. for the coming year. Experienced in both the practical and he theoretical sides of welding, he is at present director of research for the Chicago Bridge & Iron Company

COL. G. F. JENKS, first vice-president of the A.W.S. ranks as chief of the technical staff in the office of the Army Chief of Ordnance

G. O. HOGLUND, with G. S. BERNARD, JR., representing the Aluminum Company of America, will discuss spot welds in aluminum alloys

W. S. WALKER, of Linde Air Products Company, will present a paper on bronze welding before one of the technical sessions

W. G. THEISINGER, of Lukens Steel Company, is scheduled to discuss the formation of alloys in the welding of nickel-clad steel

DR. C. G. SUITS, of the General Electric Company's research laboratories, will discuss welding arcs from the standpoint of recent investigations

L. F. NENNINGER, of the Cincinnati Milling Machine Company, will collaborate with D. A. MADDOX to relate recent developments in welding machine tools

will succeed G. B. Watchouse as president, while J. P. Gill will take over the duties of vice-president.

Coincident with the change of officers announced by the American Society for Metals, the American Welding Society will also install officers for the 1938-39 term. Replacing P. G. Lang, Jr., as president will be H. C. Boardman, of the Chicago Bridge & Iron Co. Thirteen technical sessions have been planned, with simultaneous sessions included for those of highly specialized interest. Detroit meeting headquarters of the American Welding Society will be the Book Cadillac Hotel.

As in recent years a highlight of the A.S.M. sessions will be the educational courses. For the coming meeting these will consist of several discussions on pyrometry by R. B. Sosman of the U. S. Steel Corporation, along with numerous talks on the machining of various metals to be given by other authorities.

Also featured during the Metal Congress will be a round table discussion on the nature of hardness. Sponsored by the Physics of Metals Committee, the meeting will be held with D. E. Ackerman, of Purdue University, as chairman. The subject will be discussed under seven headings, a prominent research metallurgist taking the lead for each topic.

National Metal Exposition

Detroit Convention Hall

October 17–21, 1938

List of Exhibitors

(Booth number follows company name)

ACME STEEL CO., *(A-310). Stainless and galvanized steel strip.*

AETNA-STANDARD ENGINEERING CO., *(C-416). Wire drawing machine.*

AIR REDUCTION SALES CO., *(B-515). Welding and cutting torches, hard facing apparatus.*

AJAX ELECTRIC CO., *(B-116). Salt bath furnace.*

AJAX ELECTROTHERMIC CORP., *(B-116). High frequency billet heater.*

AJAX METAL CO., *(B-116). Brass, bronze, nickel and aluminum alloys. Babbitt metal.*

ALLEGHENY LUDLUM STEEL CORP., *(A-512). Allegheny Metal, Ludlite, examples of welding, spinning, drawing and machining.*

EDGAR ALLEN STEEL CO., *(B-314). Tool and die steels.*

ALOX CORP., *(B-408). Anti-corrosion products.*

ALUMINUM CO. OF AMERICA, *(B-435). Aluminum alloys.*

AMERICAN BRASS CO., *(C-410). Alloys, forgings, extrusions and die castings.*

AMERICAN BRIDGE CO., *(B-121). (See United States Steel Corp.)*

AMERICAN CAR & FOUNDRY CO., *(C-431). Rivet, bar and forging heaters.*

AMERICAN CHAIN & CABLE CO., *(C-515). (See Andrew C. Campbell Division and Page Steel & Wire Division).*

AMERICAN CYANAMID & CHEMICAL CORP., *(B-426). Case hardening compounds, chemicals.*

AMERICAN ELECTRIC FURNACE CO., *(C-422). Electric furnaces.*

AMERICAN FOUNDRY EQUIPMENT CO., *(B-542). Airless abrasive blasting machine.*

AMERICAN GAS ASSOCIATION, *(Combined Industrial Gas Exhibit). Gas heat-treating and melting equipment.*

AMERICAN GAS FURNACE CO., *(Combined Industrial Gas Exhibit). Oven furnaces, pot hardening furnaces, clean hardening heating machines.*

AMERICAN INSTITUTE OF MINING & METALLURGICAL ENGINEERS, *(B-309). Educational exhibit.*

AMERICAN MACHINE & METALS, INC., *(B-445). Hardness testing machines.*

AMERICAN MANGANESE STEEL CO., *(C-251). Small furnace castings.*

AMERICAN ROLLING MILL CO., *(A-401). Stainless steels, enameling iron, sheets and plates.*

AMERICAN SCREW CO., *(C-238). American Plus Phillips screws.*

AMERICAN SHEET & TIN PLATE CO., *(B-121). (See United States Steel Corp.)*

AMERICAN STEEL & WIRE CO., *(B-121). Wire, rods, stainless and cold finished strip.*

AMERICAN WELDING SOCIETY, *(D-313). Educational exhibit.*

AMPCO METAL, INC., *(C-425). Ampco castings and dies.*

ANDERSON & SONS, *(B-531). Etched and lithographed metal products.*

ARCOS CORP., *(A-542). Welding electrodes.*

ARMSTRONG BLUM MFG. CO., *(A-222). Bandsaws and hacksaws.*

ARMSTRONG CORK PRODUCTS CO., *(C-141). Insulating fire brick and cements.*

ATLAS FOUNDRY CO., *(A-314). Meehanite castings.*

AUDUBON WIRE CLOTH CORP., *(A-425). Flexible wire cloth for industrial applications.*

AUTOMATIC GASFLUX, INC., *(C-211). Fluxes automatically fed into gas line for welding operations.*

BABCOCK & WILCOX CO., *(A-252). Refractories.*

BALDWIN-SOUTHWARK CORP., *(B-415). Testing machines.*

W. O. BARNES CO., *(C-524). Hacksaw blades.*

BARRETT-CRAVENS CO., *(C-113). Materials handling equipment.*

BASTIAN BLESSING CO., *(A-105). Welding and cutting apparatus.*

BAUSCH & LOMB OPTICAL CO., *(A-537). Metallographic equipment, contour measuring projector, microscopes.*

BELLEVUE INDUSTRIAL FURNACE CO., *(Combined Industrial Gas Exhibit).*

BELLIS HEAT TREATING CO., *(D-306). Heat-treating salts and furnaces.*

BETHLEHEM STEEL CO., *(B-131). Deep drawn parts, operating models of steel mill equipment.*

BINKS MFG. CO., *(C-318). Spray painting equipment, water cooling towers.*

BLACK & DECKER MFG. CO., *(B-537). Portable Electric Tools.*

G. S. BLAKESLEE & CO., *(C-250). Metal cleaning apparatus.*

BOTFIELD REFRACTORIES CO., *(C-244). Refractories.*

BOYER-CAMPBELL CO., *(C-506). Face protection equipment.*

BRADLEY WASHFOUNTAIN CO., *(A-545). Sanitary equipment.*

BRAEBURN ALLOY STEEL CORP., *(D-307). Tool steel, special tools and dies.*

BRIGHT NICKEL CO., *(0000). Plating supplies and equipment.*

BRISTOL CO., *(B-407). Pyrometers, electronic controllers.*

BROWN INSTRUMENT CO., *(B-508). Indicating and controlling instruments.*

ADOLPH I. BUEHLER, *(C-234). Metallographic sample preparation equipment.*

CARBOLOY CO., *(B-203). Cemented carbide tools.*

CARBORUNDUM CO., *(A-509). Abrasives, grinding wheels, refractories.*

CARNEGIE-ILLINOIS STEEL CORP., *(B-121). Alloy steels, structural shapes.*

CARPENTER STEEL CO., *(B-259). Heat-treating of tool steels.*

CHAPMAN VALVE MFG. CO., *(A-431). Chapmanizing process, steel valves.*

CHASE BRASS & COPPER CO., *(A-519). Brass, bronze and copper welds.*

CLIMAX MOLYBDENUM CO., *(C-432). Reception space only.*

COLUMBIA STEEL CO., *(B-121). Alloy steel shapes and applications.*

CONTINENTAL INDUSTRIAL ENGINEERS, INC., *(B-144). Annealer, heat-treating machine, gas carburizer.*

CONTINENTAL MACHINE SPECIALTIES, INC., *(B-548). Contour cutting and band filing machines.*

CRUCIBLE STEEL CO. OF AMERICA, *(B-225). Tool steels.*

CYCLONE FENCE CO., *(B-121). (See United States Steel Corp.)*

CROWN RHEOSTAT & SUPPLY CO., *(B-307). Polishing equipment.*

DAYTON ROGERS MFG CO., *(B-532). Metal stampings. Holocator layout equipment.*

A. P. DE SANNO & SON, INC., *(A-107). Abrasive cutting machines.*

DESPATCH OVEN CO., *(Combined Industrial Gas Exhibit). Pot type dense load furnace.*

DETROIT REX PRODUCTS CO., *(B-545). Metal cleaning equipment.*

DETROIT TESTING MACHINE CO., *(B-306). Hardness testers.*

HARRY W. DIETERT CO., *(C-448). Spectrographic equipment.*

DOW CHEMICAL CO., *(C-115). Dowmetal castings, extrusions, sheets and plates.*

DRIVER-HARRIS CO., *(B-251). Corrosion-resisting castings and furnace parts.*

E. I DU PONT DE NEMOURS & CO., *(A-501). Electroplating unit. chemicals for industrial use.*

EBERBACH & SON CO., *(A-523). Metallographic and laboratory apparatus.*

ECLIPSE FUEL ENGINEERING CO., *(Combined Industrial Gas Exhibit). Furnaces and auxiliary equipment.*

ELECTRIC FURNACE CO., *(B-405). Samples of materials treated in specialized furnace installations.*

ELECTRIC-ALLOYS CO., *(A-411). Corrosion-resisting castings, furnace parts.*

ELECTRO METALLURGICAL CO., *(B-216). Alloy steels and cast irons.*

ELECTRONIC CONTROL CORP., *(D-316). Electronic apparatus for inspection.*

ENSIGN-REYNOLDS, INC., *(Combined Industrial Gas Exhibit). Soft metal melting furnaces, burners, gas compressors, air blowers.*

A. FINKL & SONS CO., *(B-416). Newly developed type of tempered die block.*

FIRTH-STERLING STEEL CO., *(A-217). Stainless, tool and die steels; special tools, dies and wear-resistant parts.*

J. B. FORD SALES CO., *(C-309). Metal*

cleaning solutions, burnishing compounds.

FOXBORO CO., *(A-303). Measurement and control instruments.*

FITZSIMONS CO., *(B-446). (See Monarch Steel Co.)*

GAS MACHINERY CO., *(Combined Industrial Gas Exhibit). Forging furnaces.*

GATHMANN ENGINEERING CO., *(B-105). Ingot molds.*

GENERAL ALLOYS CO., *(B-204). Heat-corrosion- and acid-resistant furnace parts.*

GENERAL ELECTRIC CO., *(A-109). Welders and accessories, products manufactured through the use of copper brazing, bright annealing and scale-free hardening in electric furnaces.*

GENERAL ELECTRIC X-RAY CORP., *(A-109). Industrial X-ray machine.*

GLOBAR DIVISION, CARBORUNDUM CO., *(A-509). Small Globar-equipped furnace.*

GOGAN MACHINE CORP., *(D-308). Hardness testers.*

CLAUD S. GORDON CO., *(B-306). Thermocouple elements and assemblies.*

GREAT LAKES STEEL CORP., *(A-317). Manufacturing processes and samples of steel.*

HALCOMB STEEL CO., *(B-225). Tool steels and alloy steels.*

HANDY & HARMAN, *(A-525). Samples of low-temperature brazing.*

HARNISCHFEGER CORP., *(A-250). Electric welding equipment and motors.*

HAUCK MFG. CO., *(C-140). Oil and gas burners, regulating valves.*

C. I. HAYES, INC., *(A-508). Heat-treating furnaces.*

HAYES-STEELITE CO., *(B-215). Cutting tools, corrosion-resistant castings.*

HEPPENSTALL CO., *(C-426). Models of automatic lifting devices.*

HEVI DUTY ELECTRIC CO., *(C-446). Bulletins, charts, specimens.*

HOBART BROTHERS CO., *(C-208). Arc welding equipment.*

A. F. HOLDEN CO., *(C-124). Heat-treating baths.*

HOLLUP CORP., *(B-252). Electric arc welders, electrodes and equipment.*

CHARLES A. HONES INC., *(Combined Industrial Gas Exhibit). Industrial furnaces and burners.*

HOSKINS MFG CO., *(A-251). Chromel heating element alloys.*

E. F. HOUGHTON & CO., *(C-221). Heat-treatment salt baths, liquid carburizer.*

ILLINOIS TESTING LABORATORIES, INC., *(B-143). Pyrometers, electronic temperature controllers, air velocity meters.*

ILLINOIS TOOL, *(A-436). Testing and inspection equipment.*

INDUSTRIAL HEATING EQUIPMENT CO., *(Combined Industrial Gas Exhibit). Continuous type draw furnace.*

INTERNATIONAL NICKEL CO., *(C-226). Alloys containing from ½ to 99.95% nickel.*

JACKSON ELECTRODE HOLDER CO., *(D-312). Welding accessories.*

JESSOP STEEL CO., *(C-141). Models of company products.*

JOHNS-MANVILLE, *(C-256). Insulating and refractory materials.*

JONES & LAUGHLIN STEEL CORP., *(A-231). Large forgings, working diorama of a steel mill.*

J. W. KELLEY CO., *(C-507). Industrial oils, heat-treating products.*

M. W. KELLOGG CO., *(C-523). Welded pressure vessels.*

C. M. KEMP MFG. CO., *(Combined Industrial Gas Exhibit). Gas analysis monitor, melting unit.*

KREMBS & CO., *(C-520) Welding equipment.*

KROUSE FATIGUE TESTING MACHINE CO., *(C-407) Various types of repeated-stress testing machines.*

LASALLE STEEL CO., *(B-142). Product samples.*

LATROBE ELECTRIC STEEL CO., *(C-510). Reception space only.*

LAVA CRUCIBLE CO., *(C-206). Refractories, ramming mixes and cements.*

LEEDS & NORTHRUP CO., *(C-218). Heat-treating furnaces, pyrometers and controlling instruments.*

E. LEITZ, INC., *(C-528). Metallographic apparatus.*

LEPEL HIGH FREQUENCY LABORATORIES, *(A-118). Metallurgical service.*

LINCOLN ELECTRIC CO., *(A-532). Arc welding equipment and supplies.*

LINDBERG ENGINEERING CO., *(B-250). Furnaces and control mechanisms.*

LINDE AIR PRODUCTS CO., *(B-221). Welding and cutting apparatus.*

MACKLIN CO., *(A-415). Grinding wheels.*

PAUL MAEHLER CO., *(Combined Industrial Gas Exhibit).*

MAGNAFLUX CORP., *(C-109). Testing and inspection units.*

MAGNETIC ANALYSIS CORP., *(A-213). Magnetic analysis equipment.*

MAHR MFG. CO., *(B-535). Nitrogen generator.*

P. R. MALLORY & CO., *(A-437). Electrodes, non-ferrous alloy parts, electrical contacts.*

MANGANESE STEEL FORGE CO., *(A-425). Manganese steel wire cloth, screens, forgings.*

MANHATTAN RUBBER MFG. CO., *(A-420). Abrasive cut-off and finishing wheels.*

MARBURG BROTHERS, INC., *(D-317). Cutting tools, gages, pneumatic hammers.*

MARQUETTE MFG. C., *(A-442). Welders.*

MAURATH, INC., *(A-426). Welding electrodes.*

MCKAY CO., *(C-548). Arc welding electrodes, industrial chain.*

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American Machinist
Booth A-546 at the Metal Show

METAL & THERMIT CORP., *(B-502). Arc welding electrodes, thermit welding equipment.*

METAL DISINTEGRATING CO., *(C-306). Samples and applications of metal powders.*

MICHIANA PRODUCTS CORP., *(A-239). Stainless steel and abrasion-resistant castings, furnace conveyors.*

MICHIGAN STEEL CASTING CO., *(C-241). Heat- and corrosion-resisting castings.*

MIDVALE CO., *(C-233). Extrusion press parts, miscellaneous forgings.*

A. MILNE CO., *(B-314). High speed, tool and alloy steels; graphitic steels.*

MOLYBDENUM CORP. OF AMERICA, *(A-515). Ferro-alloys and metal powders.*

MONARCH STEEL CO., *(B-446). Speed case steel.*

NATIONAL CYLINDER GAS CO., *(C-118). Oxy-acetylene shape-cutting machine, flame-hardening apparatus.*

NATIONAL ELECTRIC WELDING MACHINE CO., *(A-307). Seam and projection welders.*

NATIONAL TUBE CO., *(B-121). Alloy tube products and examples of applications.*

NEW JERSEY ZINC CO., *(B-106). Zinc alloy die castings.*

NORTON CO., *(A-242). Abrasives, refractories, grinding wheels and accessories.*

OAKITE PRODUCTS, INC., *(C-114). Cleaning compounds.*

OHIO CRANKSHAFT CO., *(B-260). Production hardening machines.*

OHIO STEEL FOUNDRY CO., *(A-216). Heat- and corrosion-resisting alloy castings.*

TINIUS OLSEN TESTING MACHINE CO., *(B-412). Universal testing machine, hardness tester, ductility tester, stiffness testers.*

PANGBORN CORP., *(A-131). Blast cleaning and dust collecting equipment.*

PARK CHEMICAL CO., *(C-202). Buffing, polishing and heat-treating materials.*

PARKER-KALON CORP., *(C-419). Large scale models of fastening devices.*

PARKER RUST PROOF CO., *(C-535). Corrosion protection process.*

PARTLOW CORP., *(Combined Industrial Gas Exhibit.) Gas control apparatus.*

PRODUCTION MACHINE CO., *(C-509). Polishing and finishing machines, surfacing machines.*

PYRO-ELECTRO INSTRUMENT CO., *(C-534). Hardness testing instruments.*

PYROMETER INSTRUMENT CO., *(A-114). Optical, radiation, immersion and surface pyrometers.*

QUIGLEY CO., *(A-245). Refractories.*

REEVES PULLEY CO., *(B-420). Variable speed control equipment.*

REPUBLIC STEEL CORP., *(B-231). Alloy and stainless steels, sheets, bolts, etc.*

RIEHLE TESTING MACHINE DIV., AM. MACHINE & METALS, INC., *(B-445). Testing Machines.*

ROBINSON WELDING SUPPLY CO., *(A-543). Electric and acetylene welding apparatus.*

RUSTLESS IRON & STEEL CORP., *(B-419). Rustless and stainless steels and irons.*

JOSEP T. RYERSON & SON, INC, *(B-406). Steel quality control plan.*

GEORGE SCHERR CO., *(A-445). Precision measuring and inspection equipment.*

F. E. SCHUNDLER & CO., *(B-411). Nonmetallic minerals.*

SCULLY STEEL PRODUCTS CO., *(B-121). Carbon and alloy steel shapes.*

SELAS CO., *(Combined Industrial Gas Exhibit). Combustion controllers, burners, bell type furnace.*

SENTRY CO., *(B-402). Electric high speed steel hardening furnace.*

SHAKEPROOF LOCK WASHER CO., *(A-436). Pre-assembled lock washer and screw unit.*

SLEEPER & HARTLEY, INC., *(C-215). Wire and spring making machinery.*

SPENCER TURBINE CO., *(C-144). Compressors, gas boosters, vacuum cleaners.*

STEEL CITY TESTING LABORATORY, *(A-233). Laboratory type testing apparatus.*

STIRLING DETROIT CORP., *(Combined Industrial Gas Exhibit). Gas burner tips, low-pressure blowers, gas-air mixers.*

D. A. STUART OIL CO., *(C-238). Extreme pressure lubricants.*

SURFACE COMBUSTION CORP., *(Combined Industrial Gas Exhibit). Heat-treating furnace, burner equipment.*

C. J. TAGLIABUE MFG. CO., *(C-435). Indicating, recording and control instruments.*

TENNESSEE COAL, IRON & RAILROAD CO., *(B-121). High-tensile steels.*

THOMAS STEEL CO., *(A-443). Precision gage, special finish stamping steels.*

HENRY G. THOMPSON & SON CO., *(C-254). Metal cutting saws.*

TIDE WATER ASSOCIATED OIL CO., *(C-531). Cutting oils.*

TITANIUM ALLOY MFG. CO., *(A-212). Steel, iron and aluminum castings, refractories.*

TORRINGTON MFG. CO., *(A-524). Wire manufacturing machines.*

UNA WELDING, INC., *(A-432). Welding machines and accessories.*

UNION CARBIDE AND CARBON CORP., *(B-221, B-216, B-215). Welding and cutting equipment, ferro-alloys, heat- and corrosion-resisting alloys.*

UNITCAST CORP., *(A-259). Steel castings.*

UNITED STATES STEEL CORP., *(B-121). Joint display of the products and facilities of U. S. Steel Corp. subsidiaries.*

UNIVERSAL - CYCLOPS STEEL CORP., *(A-516). Tool, stainless and specialty steels.*

VANADIUM CORP. OF AMERICA, *(C-246). Vanadium alloys and compounds.*

VICTOR SAW WORKS, INC., *(A-416). Power hack saw.*

VULCAN CRUCIBLE STEEL CO., *(A-143). Forgings, tools and special steels.*

WALL COLMONOY CORP., *(B-141). Hard surfacing materials.*

WELLS MFG. CORP., *(C-525). Metal cutting saws.*

WESTINGHOUSE ELECTRIC & MFG. CO., *(C-132). Welding equipment and electric furnaces.*

WHEELCO INSTRUMENTS CO., *(A-306). Indicating and controlling instruments.*

T. R. WIGGLEWORTH CO., *(C-518).*

WILCOX-RICH DIVISION, EATON MFG. CO., *(D-310). Fusing alloys to steel by centrifugal casting.*

H. A. WILSON CO., *(A-243). Platinum Alloys, thermostatic metals.*

WILSON MECHANICAL INSTRUMENT CO., *(C-442). Hardness testers and accessories.*

WILSON WELDER & METALS CO., *(B-515). Electric welding machines.*

WIRE ASSOCIATION, *(C-544). Educational exhibit.*

YOUNGSTOWN SHEET & TUBE CO., *(A-531). Alloy steels.*

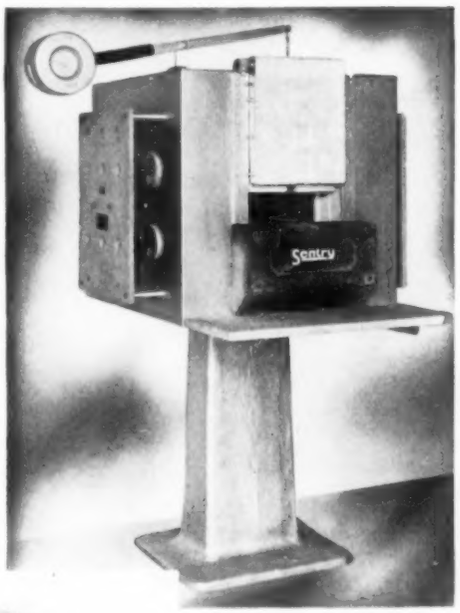
CARL ZEISS, INC., *(B-211). Optical instruments and accessories.*

SHOW IN PRINT

A preview of the new and improved equipment accessories and materials that will be displayed at the National Metal Exposition, to be held in Detroit, October 17–21

Sentry No. 3 Model Y Electric Furnace

The Sentry Co., Foxboro, Mass., is introducing the No. 3 Model Y electric furnace for hardening high-speed tools with the Sentry diamond-block method of atmospheric control. Like the previously introduced smaller furnaces of this type, the No. 3 furnace has a full-muffle and is equipped six heating elements, three above the muffle and three below, thus assuring uniform heat distribution. This unit will heat from cold to 2,350 F. in 75 min. and current consumption at this temperature is between 5½ and 15 kw. depending on the amount of work hardened. Muffle is 8⅞ in. wide, 4 in. high and 16 in. deep. Maximum rating of the furnace is 26 kw. It can be connected direct to a 220 volt circuit.



Over-all dimensions of the No. 3 Model Y electric furnace are 40 in. wide, 35 in. deep and 65 in. high, with the hearth 47 in. above the floor

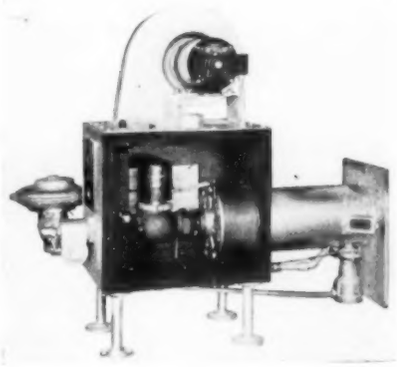
Gordon Type 1100 Portable Furnace

Tempering and drawing operations on small parts can be performed in tool rooms or production departments with the Type 1100 electric furnace offered by the Claud S. Gordon Co., Inc., 1524 S. Western Ave., Pilsen Station, Chicago, Ill. This furnace has an electric element designed to maintain an approximately constant temperature of 1,050 F. in the salt bath, even though the liquid level of the bath may vary over a wide range.

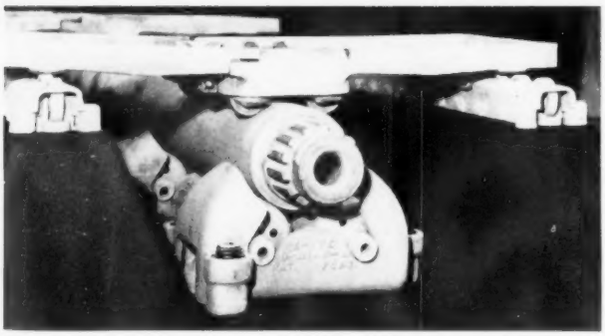
Power consumption of the Gordon Type 1100 electric furnace is 900 watts. Pot is drawn from corrosion resistant metal

Eclipse "Gas Gun" Combustion Unit

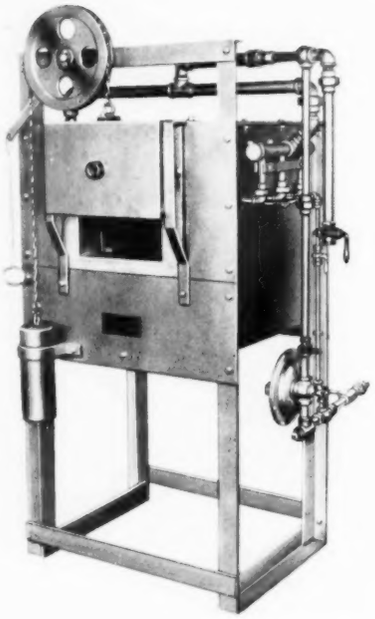
Developed as a complete combustion unit, the Gas Gun being shown by the Eclipse Fuel Engineering Co., Rockford, Ill., primarily is applicable for firing ovens, boilers, air heaters and other units where a single-flame burner can be applied. This unit develops a soft flame with about 50 per cent of the required air in the primary mixture and the balance as



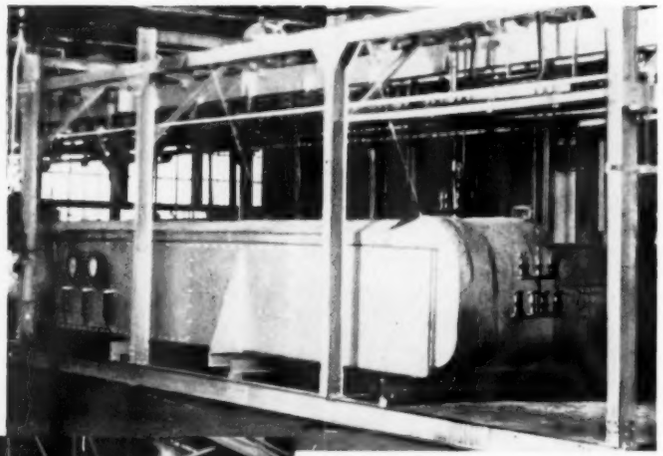
Automatic control can be applied easily to the "Gas Gun" combustion unit for firing ovens

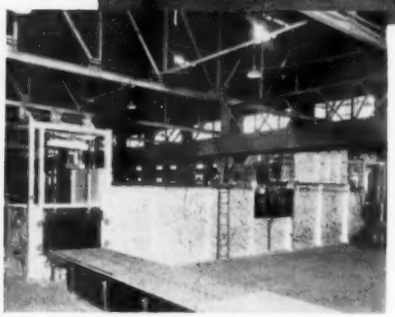


Alloy weight and maintenance are reduced through installation of the "Smooth Screw" furnace conveyor in through-pipe furnaces. This conveyor can be set for any desired rate of speed



Supplementary gas burners on this No. 150 furnace produce an atmosphere rich in carbon monoxide





Special gas preparation equipment is not required for the muffleless gas carburizer developed by Continental. Operator only has to load and unload the material

This automatic machine for salt bath hardening automatically transfers the material through each of the various stages of the hardening process

secondary around the nozzle. As all air is supplied by the blower the "Gas Gun" can be set up tight against the appliance to be fired. However, leaving a slight opening will not affect the operation of the unit.

To light up the burner, it is necessary only to turn on the gas and supply electric current. The rest of the cycle is entirely automatic. To shut down the gun, it is necessary only to turn the switch off. This closes all gas valves, stops the blower and closes the air shutter so that there is no air drawn through by natural draft. A built-in "Flame-Otrol" unit controls the gas supplied to the main burner.

A.G.F. Gas Burners For Protective Atmospheres

Supplementary gas burners developed for producing a rich protective atmosphere within the heading chamber of a furnace have been announced by the American Gas Furnace Co., Elizabeth, N. J., and will be shown mounted on a No. 150 high speed steel furnace. The regular heating burners on this furnace are of standard design, however, in place of firing into the hearth they fire under the arch and the products of combustion are vented under the hearth slab. The atmosphere burners produce the supplementary gas necessary to obtain a furnace atmosphere rich in carbon monoxide without interfering with the rapid, uniform heating necessary for hardening high-speed steel.

Continental Carburizer and Automatic Heat-Treater

Continental Industrial Engineers, Inc., 201 N. Wells St., Chicago, Ill., have developed and placed in operation an improved continuous gas carburizing furnace and an automatic salt bath heat-treating machine which consolidates in one unit all of the processes necessary to case-harden and draw steel parts. The complete muffleness gas carburizer consists of a carburizing furnace approximately 42 ft. long, a rapid cool zone approximately 15 ft. long, a reheat section about 12 ft. long, oil quenching, washing and rinsing equipment, and a 20 ft. long draw furnace. A return table connects the end of the draw furnace with the load and unload position.

The carburizing furnace is constructed without a conventional alloy muffle and trays are used to convey

the material on rails through the furnace. Gas for the carburizing operation is turned directly into the furnace, where it surrounds the material and produces the desired case without any undesirable deposit. The material comes from the carburizing furnace clean and free from scale. Entire process is automatic and the complete operation is handled by one operator. Natural gas is used for fuel as well as for the curburizing gas.

Automatic salt bath hardening machine automatically carries material through a pre-heat furnace, which is held automatically at a predetermined temperature, then transfers it directly into the salt bath. After being carried through the salt bath, the material automatically is transferred to an oil quench tank where it is held for a predetermined period. Next, it is delivered to a working and cleaning section of the machine. From this cleaning section, the material is carried to a draw furnace, from which it is returned to a loading and unloading position.

Transfer mechanism which carries the parts from the preheat furnace to the bath, and from the bath to the quench and wash positions is designed so that these transfers are made rapidly in such a position that warpage does not occur. The entire cycle can be set according to requirements of the metallurgist. Machine is inclosed in a vapor-proof housing which is connected to a vent duct. From 500 to 1,000 lb. of material per hour can be case-hardened, depending on its size and shape. Working models of these two units will be in operation at the Metal Show.

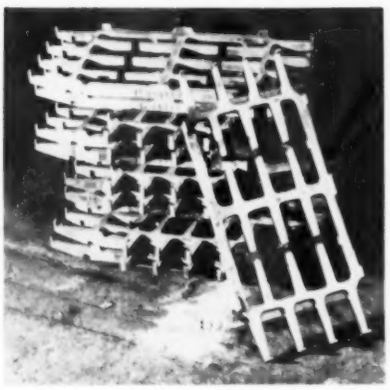
"Smooth Screw" Conveyor For Furnace Applications

General Alloys Co., 409 W. First St., Boston, Mass., has developed the "Smooth Screw" alloy conveyor to replace pusher-type heating arrangements for furnace applications. This conveyor will operate at any desired speed and is reversible. It is self-emptying and can be run at any percentage of production. One tray or a full load of work can be run through the furnace.

Fully adjustable bearings on the tray rollers are renewable and can be equipped to give any feed ratio desired. The mill-type hot bearing used to support the feed roll is equipped with an adjustable three-point support screw. Muffle side rails which support the trays at each end are of "Xite" and are equipped with renewable low friction bearings in the rollers. Capacity of the feed roll is 2,000 lb. per foot of length.

Driver-Harris Tray For Carburizing

A cantilever-arm design of nickel-chromium trays for use in carburizing furnaces of both the continuous and the batch types has been developed by the Driver-Harris Co., 942 Book Bldg., Harrison, N. J. This construction consists basically of a frame with a central member and with cantilever arms. There are no criss-crossing members continuously joined. This design permits free expansion and contraction of the alloy mass under the usual furnace operating temperatures of from 1200 to 2000 F. It is claimed that no severe strains are set up in the cantilever-arm tray.



Driver-Harris trays for carburizing furnaces have cantilever arms to permit free expansion while in the furnace

Berwick No. 1-1 Type C Horizontal Heater

Spot heat for upset work, tempering or annealing can be provided by the No. 1-1 Type C Berwick horizontal one-electrode electric heater developed by American Car & Foundry Co., 30 Church St., New York, N. Y. This heater is equipped with a low-temperature photoelectric cell control to work from 1,100 to 2,300 F. and has a time-clock to give a soaking heat from less than a second upward. A resistor provides increased or decreased resistance to control the rate at which material is heated.

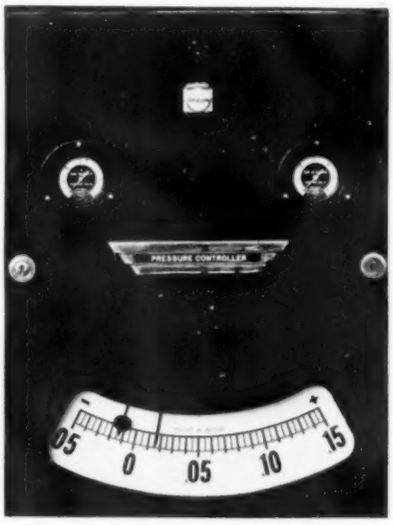
Photoelectric control is provided on the one-electrode Type C Berwick heater

B.&W. Refractory Insulating Concrete

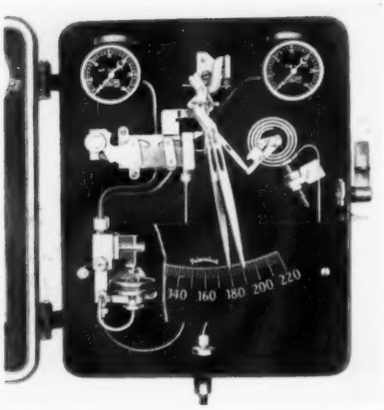
Materials for making light-weight concrete for refractory insulation purposes have been developed by the Babcock & Wilcox Co., 19 Rector St., New York, N. Y. The "Light-Weight Aggregate" must be mixed with both cement and water to form a concrete, while the two premixed materials—"K-20" concrete mix and "K-22" concrete mix—require only the addition of water to form concrete. The K-20 mix is suitable for 2,000 F. service while the K-22 mix can be used up to 2,200 F. These three materials are shipped in bags, each containing a sufficient amount of material to form one cubic foot of cast concrete.

Brown "Air-o-Line" Pressure Controller

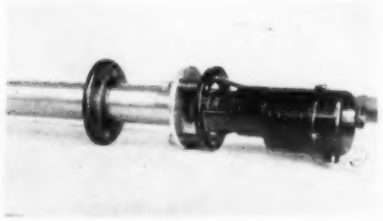
The Brown Instrument Co., 4501 Wayne Ave., Philadelphia, Pa., has developed the "Air-o-Line" furnace



Indication and control of low-range pressures is possible with the "Air-o-Line" furnace pressure controller shown by Brown

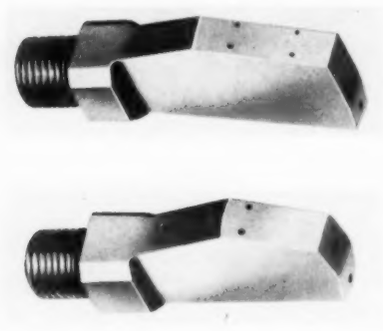


The Model 9-TIC direct-set temperature controller developed by Tagliabue has an interchangeable calibrated tube system



The Wheelco radiation head can be equipped with various types of target tubes for use with controllers or indicating pyrometers

Improved "Pyro" immersion pyrometer is available with a straight or adjustable shaft



Four- and six-flame Lindewelding tips make possible increased welding speeds

pressure controller for indicating and controlling low-range pressures and draft. This controller essentially is a sensitive, inverted-bell type draft indicator combined with the "Air-o-Line" control unit. Automatic reset and fully adjustable throttling range prevents the furnace pressure from lining out at some point other than the control point and is claimed to eliminate overcorrecting and cycling. It is applicable for controlling any pressure in the range from —5.0 to +5.0 in. of water.

"TAG" Model No. 9-TIC Indicating Controller

The Model No. 9-TIC direct-set indicating temperature controller to be exhibited by The C. J. Tagliabue Mfg. Co., Park and Nostrand Aves., Brooklyn, N. Y., includes an interchangeable calibrated tube system, a safety link for range protection, pointer arm brackets with bearings at each end and the use of stainless steel for all important parts. A companion unit is the Model No. 9-PIC direct-set indicating controller for pressure control. Both of these controllers can be supplied in "on-off" or "throttling" types and have direct-set features, the white control pointer and the red setting pointer indicating on a 5½-in. graduated scale.

Wheelco Improved Radiation Head

Available either with or without target tubes, the improved radiation head assemblies developed by Wheelco Instruments Co., 1929–1933 S. Halsted St., Chicago, Ill., are particularly suitable for measuring incandescent surface temperatures, or the temperature of work in motion. They also are suitable for use where maintenance of thermocouples is expensive.

Relays for Capacitrol instruments, previously mounted integrally and wired directly into the unit, now are arranged so that they can be plugged in, in the same manner as a radio tube.

"Pyro" Improved Immersion Pyrometer

Available in two models, the "Pyro" improved immersion pyrometer announced by The Pyrometer Instrument Co., 103 Lafayette St., New York, N. Y., is particularly suitable for use with non-ferrous metals. The thermo-couple indicator and lead wire are combined into one self-contained portable unit. It can be carried and operated by one hand. Interchangeable thermo-couples are available and the instrument can be furnished with a straight shaft, or an adjustable shaft as shown. The straight-shaft model A has an over-all length, without thermo-couple of 23 in. and weighs 3½ lb. The adjustable Model B unit is 35½ in. long without thermo-couple and weighs 3½ lb.

Linde Multi-Flame Preheating and Welding Tips

The multi-flame welding tips have been developed by the Linde Air Products Co., 205 E. 42nd St., New York, N. Y., for welding pipe lines and similar applications. These tips are claimed to increase welding speeds 25 per cent or more and to give a reduction in gas consumption. The four-flame tip has been designed for position welds, while the six-flame tip is intended primarily for rolling welds.

Airco No. 20 Travograph For Flame Cutting

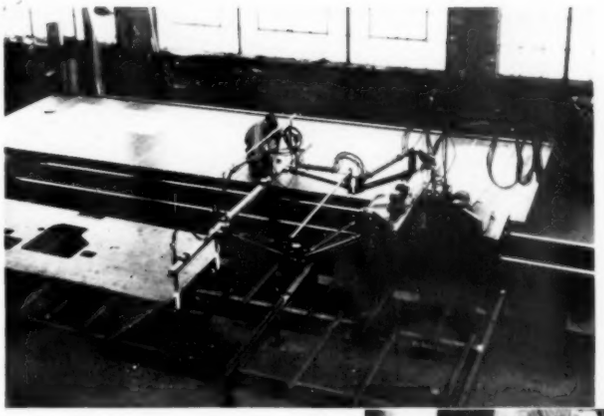
The No. 20 Travograph, developed by Air Reduction Sales Co., 60 E. 42nd St., New York, N. Y., for gas-cutting applications, has a practical cutting area of 10 ft. in width by any length which the work may demand. Tracks supplied as standard for this machine are 16 ft. long and will provide a cutting length of 11 ft., but this may be increased to any extent by the addition of similar length track. With this machine, it is possible to cut at any point within the area of the largest plates commonly available. This may be accomplished with one torch for single cuts, or by employing four or more torches for multiple cutting simultaneously.

Separate tables are used for supporting the drawing or templet to be traced and therefore the work to be cut. All hose and electric wiring are suspended above the operating arm so as to clear them from possible interference with the work. Manual, or magnetic tracers may be used to control the speed and direction of the cut, or a mechanical templet follower can be used. The tracer wheel is driven by a motor mounted on the vertical shaft head and provided with a speed control.

G. E. Thyratron-Controlled Automatic Welding Head

High welding speed and continuous operation of the arc are features of the Thyraton-controlled automatic arc welding head developed by Gen-

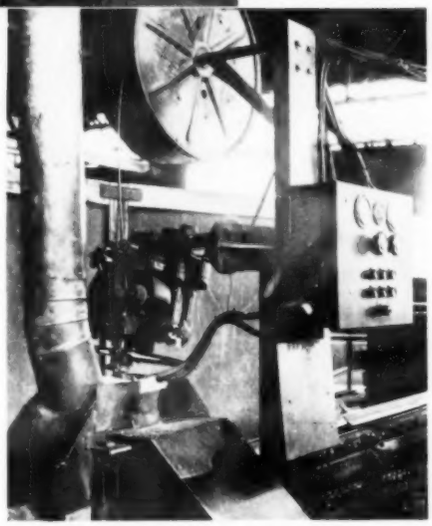
eral Electric Co., Schenectady, N. Y., for production welding operations. The electronic tube control operates the wire feeder. A ventilated inclosure around the arc protects workers from the light and smoke of the welding operation. Tapered electrode-feed roles, together with a simplified gear-motor drive for the feeder, are claimed to permit the mechanical equipment to keep pace with the wide-range, high speed response of the electronic tube control. The electrode is fed from a reel mounted above the head.



High-speed production welding is possible with the Thyratron-controlled arc welding head

Mallory Offset Welding Tip Holders

A line of offset water-cooled welding tip holders, suitable for spot welding in corners without using goose-neck electrodes, has been developed by P. R. Mallory & Co., Inc., 3029 E. Washington St., Indianapolis, Ind. These holders are available in 2 and 4 in. lengths with a straight tip seat, as shown, or with a 30 deg. angle seat. Shank diameters range from $\frac{7}{8}$ to $1\frac{1}{4}$ in. in both types. The holders arranged for use only with spot welding tips have tapered shanks.



Three types of tracers are available for use with the No. 20 Travograph gas-cutting machine. Motor driving the tracer wheel is provided with a tachometer

Offset water-cooled welding tip holders are available with straight or angle seats

Zeiss Hardness Test Microscope

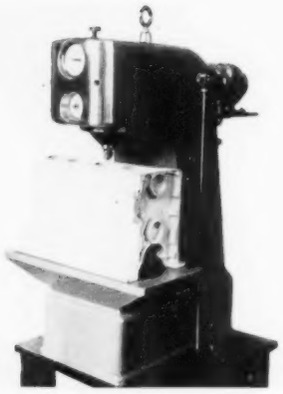
An improved optical system, using a new method for illuminating the impression so that its contours appears more clearly defined than in diffused daylight or lamp light, is built in the hardness test microscope announced by Carl Zeiss, Inc., 485 Fifth Ave., New York, N. Y. The image thus produced can be measured by the optical micrometer and it is claimed that readings can be repeated within close limits. The ocular head can be swivelled through 90 deg. so that the diameter of the Brinell impression can be measured conveniently in both directions without moving the object. Magnifications of 24X and 48X are provided, the higher magnification being intended chiefly for very small impressions. Work as high as $4\frac{3}{8}$ in. can be handled and the effectiveness stage surface is $3\frac{7}{8}$ x 7-in.

The Zeiss hardness test microscope can be swiveled to take measurements in both directions across the test impression

Busch "Metaphot" Combination Microscope

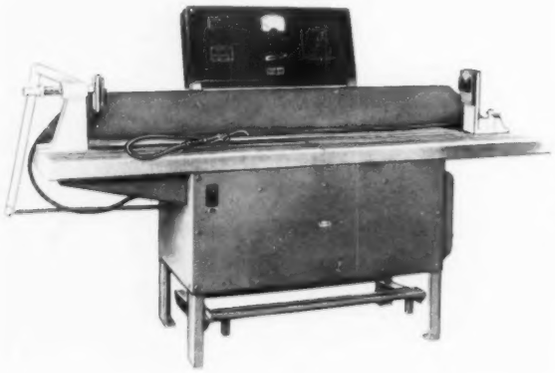
An improved Busch "Metaphot" metallurgical microscope, which combines a microscope and photographic camera assembled in one permanently aligned unit, will be exhibited by the George Scherr Co., 128 Lafayette St., New York, N. Y. Instead of a

Microscope and photographic camera are assembled as a permanently aligned unit offered in the "Metaphot" metallurgical microscope

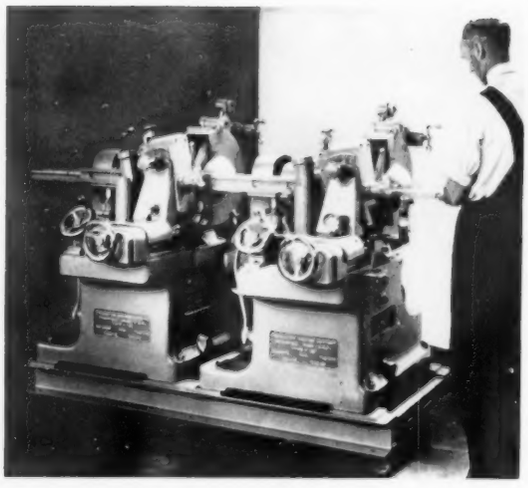


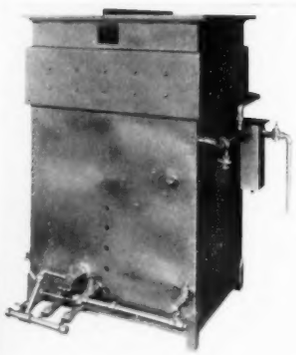
Special fixtures may be mounted on the base of this direct-reading hardness tester

Adjustable shield covers the penetrator of the Model PR Pyro-Universal tester, except during contact with the specimen



The Model DT magnetizer can be used for demagnetizing by reducing the current in gradual steps





The Model R-1 degreaser will clean 350 lb. of miscellaneous articles per hour, while the Model R-2 unit has capacity for 1,000 lb. per hour

More than 200 rods, each 10-in. long, can be polished and buffed each minute in this No. 101 tandem unit

bellows, the camera on this instrument is equipped with a new "Vario Ocular" device which changes the magnification of any eyepiece optically at the turn of a dial. Hence, the ground glass remains always in the same fixed position in front of the observer. Standard magnifications of 100, 200, 500, 1000 and 2000 diameters are claimed to be obtained easily. Illumination can be changed instantly from bright field to dark field, with vertical or oblique lighting.

Detroit Improved Hardness Tester

Detroit Testing Machine Co., 5137 Trumbull Ave., Detroit, Mich., has improved this direct-reading hardness testing machine by completely redesigning the entire mechanism. Mechanical and electrical clutches have been eliminated. The operating mechanism eliminates the use of a piston return spring and the piston is of a self-guided type. All piping and operating valves, as well as the reservoir, is located within the body of the machine. Work screw and screw support may be locked rigidly, preventing shake and wear. The top of the base, directly under the test ball, is machined to provide footing for special fixtures if required.

Magnaflux Model DT Magnetizing Unit

Built to accommodate parts up to 72 in. long, the Model DT transformer-type magnetizing unit developed by Magnaflux Corp., 605 W. Washington St., Chicago, Ill., is provided with a tank for holding the liquid inspecting medium, and a circulating pump and hose for flowing the liquid over the part while it is between the heads of the machine. This unit provides means for magnetizing circularly by the use of low-voltage a.c. supplied from the secondary of the transformer to two contact heads. The part to be magnetized is placed between the contact heads in a horizontal position. Model D unit is similar to the Model DT, with the exception that the tank for holding the liquid, pump and hose are not furnished.

Model PR Pyro-Universal Direct-Reading Tester

A maximum load of 150 kg. can be applied with the Model PR Pyro-Universal direct-reading hardness tester offered by Pyro-Electro Instrument Co., 7323-5 W. Chicago Blvd.,

Detroit, Mich. This instrument will give comparative C, B, and A scale hardness readings. It is designed for testing in volume production and is arranged for 1,920 tests per hour with manual feed or 2,580 tests per hour with automatic feed.

Throat depth of this unit is 7 in. and it has a vertical capacity of 6 in. in the standard size. It is calibrated for a load of 150 kg. on the C scale using a diamond penetrator; 60 kg. on the A scale using a diamond penetrator; and 100 kg. on the B scale using a $\frac{1}{16}$ or $\frac{1}{8}$-in. diameter ball. Net weight of the instrument is 280 lb. and its overall dimensions are 29½ x 23 x 8 in. The elevating anvil compensates for variations in stock to tolerances in excess of 0.125 in. A minor load of approximately 10 kg. dead weight is applied automatically and is constant.

Production Type 101 Tandem Buffer

Developed especially to polish and buff shock absorber piston rods having a length of approximately 10-in., the Type 101 tandem polisher and buffer offered by Production Machine Co., Greenfield, Mass., uses felt wheels. Rods first are ground to size, chromium-plated and then brought to this machine for final polishing and buffing. Production is approximately 1,200 pieces per hour. A special attachment was developed for feeding the finishing compound to the wheels. The work support was lined with felt to protect the surface of the parts being buffed. This is a close-coupled unit, but the machines can be used separately if desired. Each machine is provided with individual motor drive.

Blakeslee Improved Model R Degreaser

Improvements made in the Model R degreaser by G. S. Blakeslee & Co., 19th St. and 52nd Ave., Cicero Station, Chicago, Ill., include the addition of a water separator so that removal of water from the degreasing system is continuous. In addition, a quick-opening cleanout door facilitates cleaning the unit during periodic distillations, and a removable pan has been placed below the gas burner. The unit is self-distilling, so that whenever the "Blacosolv" solvent becomes contaminated with oil and dirt it may be reclaimed. The unit may be heated by steam, gas or electricity. Where gas or electric heat is used, the solvent is protected against over-heating by a thermostat.

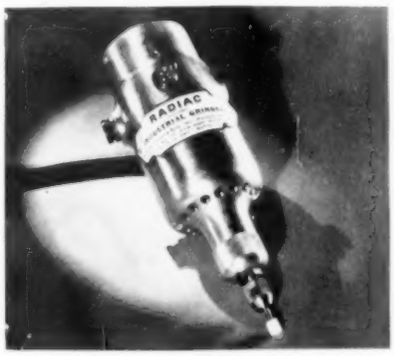
Torrington No. W-11 Automatic Spring Winder

The model W-11 spring winding machine offered by Torrington Mfg. Co., Torrington, Conn., for automatic high-speed forming of coil springs is operated from centralized controls and is equipped with Timken roller bearings throughout. Diameter and pitch controls are manipulated by hand screw knobs at the top of the machine. Wire feed adjustment is claimed to be simple and the machine with standard equipment will take all wire sizes within its rated capacity without change.

All types of compression and extension springs can be wound on the Model W-11 spring making machine

"Radiac" Electric Industrial Grinder

The "Radiac" industrial grinder, being shown by A. P. de Sanno & Son, Inc., 1615-1623 McKean St., Philadelphia, Pa., is equipped with a $\frac{1}{8}$ hp. air-cooled, ball-bearing electric motor and operates at 18,000 r.p.m. Weight is 32 oz. and the grinder is equipped with a collect-type chuck of $\frac{1}{8}$-in. mandrel capacity. A toggle switch is located in the case convenient for the operator's hand. Standard equipment includes six mounted points of assorted shapes and sizes, a dressing stone, two wrenches, and a 10 ft. rubber-covered cord with attachment plug.



A steel bracket is available for mounting the "Radiac" industrial electric grinder in tool posts of lathes for interal grinding operations

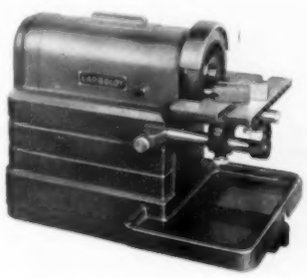
"Doall" Attachments For Model ML Saw

Improved, quick-acting tool bit saw guides, an improved mitered cut-off fixture and a disk cutting attachment have been developed by Continental Machine Specialties, Inc., 1301 Washington Ave. S., Minneapolis, Minn., for use on the Model ML "Doall" sawing and filing machine. Arm of the disk cutting unit clamps to the 1 x 1½ in. upper saw guide post and adjustment of the centering pin may be made to accommodate diameters from 2½ to 24 in. Adjustment for thickness will accommodate orf n.No. 16 gage stock to blocks 8½ in. thick. The quick-adjusting tool bit saw guides hold the blade close to the top surface of the work.

Improved saw guides, a mitered cut-off fixture and a disk cutting attachment increase the adaptability of the Model ML "Doall" saw

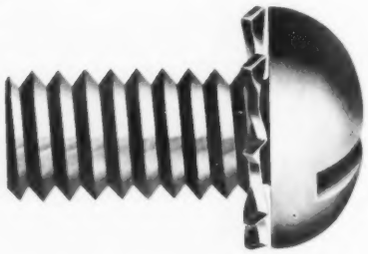
Carboloy Bench-Type Carbide Tool Grinder

Economical sharpening of cemented carbide tools, in sizes up to 1-in. square or equal cross section, with diamond wheels and lapping discs is possible with the improved bench-type grinder offered by the

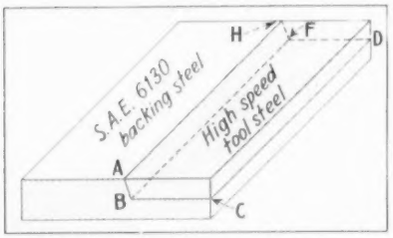


Carbide tools up to 1 in. square, or equal cross section, can be sharpened economically on this bench-type grinder

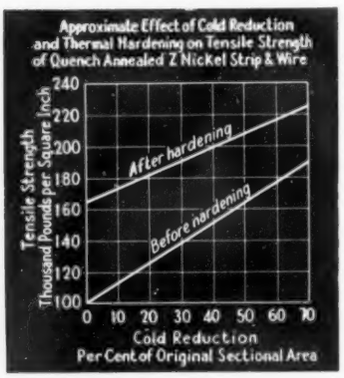
A full line of screwdrivers and power bits are available for driving "Phillips" recessed-head self tapping screws



No screw can be applied without having a lock washer under the head when using the "SEMS" pre-assembled fastening unit



Type R composite knife stock is suitable for use as shear blades, stone cutters, lathe tools and dies



Approximate effect of cold reduction and thermal hardening Z Nickel strip and wire is indicated by this chart

Carboloy Co. Inc., 2989 E. Jefferson Ave., Detroit, Mich. A quick-setting graduated dial, with large graduations, permits accurate angular adjustment of the table to maintain correct rake and clearance angles. The adjustable tool rest table is mounted across the face of the wheel and a slot is provided for a tool guide protractor, making it possible to grind angles on the tool without checking by hand. Distance from the wheel to the tool rest is adjustable and forward and reverse rotation of the wheel facilitates grinding both right and left hand tools. Drive is from a $\frac{1}{4}$ hp. reversible motor.

Parker-Kalon "Phillips" Recessed-Head Screws

A line of "Phillips" recessed-head thread-cutting sheet metal screws is offered by Parker-Kalon Corp., 200 Varick St., New York, N. Y. The recess in the head of these screws is such that the screw will cling to the screwdriver point, permitting driving the screw in hard-to-get-at places. The screwdriver cannot slip out of the recess, since it engages in four tapered grooves with the pressure evenly distributed.

These screws are offered in two types with four head styles. Type Z is recommended for joining and making fastenings to sheet metal ranging from No. 24 to No. 6 gage, as well as for making fastenings to aluminum and die castings, as well as plastics. It can be removed and replaced. The Type A screws are for sheet metals not heavier than No. 18.

"SEMS" Pre-Assembled Fastening Unit

Lock washer cannot drop off the pre-assembled "SEMS" fastening unit announced by the Shakeproof Lock Washer Co., 2501 N. Keeler Ave., Chicago, Ill. This machine screw unit is said to reduce labor costs and speed up production through the elimination of time required to assemble lock washers on the screws. Each screw is equipped with the correct size of lock washer for its particular type of head.

Jessop Type R Composite Knife Stock

Both high-speed tool steel and high carbon high chrome steel, as well as other types, can be used as insert material in the Type R composite steel stock developed by Jessop Steel Co., Washington, Pa. Backing steel is S.A.E. 6130, which has proven particularly satisfactory for this purpose. In assembling this stock, the Armstrong method of electropickling and electrodeposition of iron onto the insert prior to assembly is used. Certain variations in technique have been devised to insure a proper vertical weld along the plane BCDF shown in the accompanying sketch. Customarily the bevel of the plane ABFH is 15 deg., but this can be held to a minimum of 10 deg.

Acme "Lustro" Galvanized Lacquered Superstrip

"Lustro" Galvanized Lacquered Superstrip announced by Acme Steel Co., 2836 Archer Ave., Chicago, Ill., has a bright electro-galvanized coating and is lacquered to preserve the finish and prevent discoloration of the zinc. This material can be drawn in presses or formed in roller dies. The finish is said to provide a good base for coloring by spray or brush method. It is furnished in all widths up to and including 8 in. and ranges in thickness from 0.015 to 0.095 in. It can be furnished in any length, whether cut in lengths or in coils.

"Sturaco" Extreme Pressure Industrial Lubricants

A line of "EP" extreme pressure lubricants for machine tools and similar applications where bearing and gear tooth pressures have been increased beyond the capacity of ordinary petroleum lubricating oils and greases, has been made available by the D. A. Stuart Oil Co. Ltd., 2733 S. Troy St., Chicago, Ill. A full line of these "EP" industrial oils and greases will be demonstrated.

"Inco" Z Nickel Has High Strength

Samples of Z Nickel, which combines the corrosion resistance of nickel with the mechanical properties of heat-treated steel, will be exhibited by the International Nickel Co. Inc., 67 Wall St., New York, N. Y. This alloy contains 98 per cent nickel and has a strength of from $2\frac{1}{2}$ to 4 times that of ordinary structural carbon steel. It has been produced with a tensile strength as high as 250,000 lb. per sq. in. and with hardness values as high as 46 Rockwell C. In its unhardened or annealed condition Z Nickel fabricates almost as easily as pure nickel. The metal can be heat-treated after fabrication with little if any distortion, since heat-treating operations are at temperatures of 890-930 F. for 6-16 hr.

The Working of STAINLESS STEELS

FOR CENTURIES men have watched their handiwork in iron and steel yield to rust and gradually crumble away. The prospect of finding some way to make steel resist corrosion and thus perpetuate its beauty and utility was an inviting one. Early experimenters were elated by the discovery that a relatively high percentage of chromium combined with steel would produce a metal that resisted staining by ordinary acids.

Berthier, in 1821, described the acid-resisting properties of iron-chromium alloys. Thirty years later, Monnartz noted the effect of an increased chromium content in greater resistance to nitric acid and to atmospheric attack. In 1913, Harry Brearley, while seeking an alloy for small rifles and liners for naval guns, observed these same unusual qualities and in addition the beneficial effects of heat-treatment. His findings led to the development of stainless steels for cutlery, and eventually the 14 to 18 per cent chromium alloys, with sufficient carbon for heat-treating, were universally adopted for this purpose. From these early beginnings, stainless steel has found a multitude of uses and its field of application widens daily.

Stainless steel is not a single alloy but rather an entire family of alloys. There are three main branches of this family:

1. The martensitic steels, composed mainly of chromium, iron and carbon. These steels are magnetic and can be hardened and tempered by heat-treatment in the same manner as ordinary carbon steels except that these steels harden intensely when cooled in air.

2. The ferritic steels which contain chromium in excess of 18 per cent, are non-hardening and, therefore, cannot be heat-treated. When properly annealed they are relatively strong and ductile.

3. The austenitic steels, composed chiefly of chromium, nickel, iron and manganese. These steels are non-magnetic and cannot be hardened by heat-treatment. In the annealed condition they are relatively stiff, but extremely ductile. All of these steels harden excessively when worked either hot or cold.

The percentages of main alloying elements vary considerably. In addition, small percentages of copper, silicon, molybdenum, selenium, sulphur, zirconium and other constituents are added for special purposes.

The user must understand that the overall designation "stainless steel" does not in fact describe a single metal with a single set of working characteristics. As a matter of fact, the grades differ widely from each other and from other kinds of steel as regards workability. Only by a basic knowledge of the main classifications of stainless steels and their response to metal-working operations can the user hope to machine, weld, heat-treat and perform other steps that are necessary in the processing of these materials.

On these pages is summarized much of the needed information. A good part of the data is given in tabular or graphical form. Not all of the dozens of grades and modifications and not all of the metallurgical findings that have been gathered in recent years are included. The attempt has been made to give a concise summary of classifications and characteristics that will afford a practical guide to the metal-working executive who finds that increasingly severe demands on his product call for a greater use of stainless steel.

Due credit is given the following organizations for data supplied by them toward the preparation of this section:

Allegheny Steel Company
American Rolling Mill Company
American Society for Metals
Carpenter Steel Company
Jessop Steel Company
The Linde Air Products Company
Ludlum Steel Company
Republic Steel Company
Rustless Iron and Steel Corporation
United States Steel Company

CORROSION RESISTANCE

This table indicates the behavior of three typical stainless steels to representative chemicals. Actual service conditions frequently alter behavior, some impurities inhibiting corrosion, others accelerating it.

Symbol	*Explanation*
A	Complete resistance would be expected.
B	Slightly corroded, varying from tarnishing to light attack; deserving of consideration for some uses.
C	Corrosive attack generally too high to warrant consideration.

ACIDS

Chemical	*Conditions*	*No. 302*	*No. 430*	*No. 410*
Acetic Acid	5%—Room Temp.	A	A	B
Acetic Acid	20%—Room Temp.	A	B	C
Acetic Acid	100%—Room Temp.	A	C	C
Acetic Anhydride	Room Temp.	A	C	C
Benzoic Acid	5%—Room Temp.	A	A	A
Boric Acid	5%—Boiling	A	A	A
Butyric Acid	5%—Boiling	A	A	A
Carbolic Acid	5%—Boiling	A	A	A
Citric Acid	5%—Room Temp.	A	B	B
Citric Acid	25%—Boiling	A	C	C
Chromic Acid, c. p.	10%—Room Temp.	A	B	B
Formic Acid	5%—Room Temp.	B	C	C
Gallic Acid	5%—Room Temp.	A	A	A
Hydrochloric Acid	All Concentrations	C	C	C
Hydrofluoric Acid	All Concentrations	C	C	C
Lactic Acid	5%—Room Temp.	B	C	C
Malic Acid	5%—Room Temp.	A	A	A
Nitric Acid	5%—Room Temp.	A	A	B
Nitric Acid	50%—Room Temp.	A	A	A
Nitric Acid	65%—Boiling	B	B	C
Oleic Acid	Concen., 200° F.	A	A	A
Oxalic Acid	5%—Room Temp.	A	B	C
Phosphoric Acid	5%—Room Temp.	A	B	B
Stearic Acid	Concen., 200° F.	A	A	A
Sulphuric Acid	Dilute, Room Temp.	C	C	C
Sulphuric Acid	Con., Room Temp.	A	A	A
Sulphurous Acid	Saturated, Room Temp.	B	B	C
Tannic Acid	10%—Room Temp.	A	A	A
Tartic Acid	10%—Room Temp.	B	C	C

SALTS

Chemical	*Conditions*	*No. 302*	*No. 430*	*No. 410*
Aluminum Sulphate	10%—Room Temp.	B	C	C
Aluminum Chloride	5%—Room Temp.	B	C	C
Aluminum Fluoride	5%—Room Temp.	B	C	C
Ammonium Hydroxide	Room Temp.	A	A	A
Ammonia Liquor	Room Temp.	A	..	..
Ammonium Bromide	5%—Room Temp.	B	B	B
Ammonium Chloride	5%—Room Temp.	B	B	B
Ammonium Carbonate	Hot or Cold	A	A	A
Ammonium Nitrate	5%—Room Temp.	A	A	A
Ammonium Oxalate	5%—Room Temp.	A	A	A
Ammonium Phosphate	5%—Room Temp.	A	A	A
Ammonium Sulphate	10%—Room Temp.	A	B	B
Ammonium Sulphate	10%—Boiling	B	B	C
Barium Chloride	5%—Room Temp.	A	A	B
Calcium Chloride	5%—Room Temp.	B	B	B
Calcium Hypochlorite	3%—Room Temp.	B	C	C
Calcium Hydroxide	5%—Room Temp.	A	A	A
Copper Chloride	1%—Room Temp.	C	C	C
Copper Cyanide	Plating Solution	A	A	A
Copper Nitrate	5%—Room Temp.	A	A	A
Copper Sulphate	10%—Room Temp.	A	A	A
Ferric Chloride	5%—Room Temp.	C	C	C
Ferric Nitrate	5%—Room Temp.	A	A	A
Ferric Sulphate	5%—Room Temp.	A	A	A
Ferrous Sulphate	5%—Room Temp.	A	A	A
Magnesium Chloride	5%—Room Temp.	B	B	B
Magnesium Hydroxide	Thick Susp., Room Temp.	A	A	A
Mercuric Chloride	Dilute, Room Temp.	C	C	C
Potassium Dichromate	5%—Boiling Point	A	A	A
Potassium Bromide	5%—Room Temp.	B	B	B
Potassium Carbonate	Room Temp.	A	A	A
Potassium Chloride	5%—Room Temp.	B	B	B
Potassium Hydroxide	5%—Room Temp.	A	A	A
Potassium Nitrate	5%—Room Temp.	A	A	A
Potassium Sulphate	5%—Room Temp.	A	A	A
Sodium Acetate	5%—Room Temp.	A	A	A
Sodium Carbonate	Room Temp.	A	A	A
Sodium Chloride	5%—Room Temp.	B	B	B
Sodium Bromide	5%—Room Temp.	B	B	B
Sodium Fluoride	5%—Room Temp.	B	B	B
Sodium Hydroxide	10%—Room Temp.	A	A	A
Sodium Hypochlorite	5%—Room Temp.	B	C	C
Sodium Nitrate	Room Temp.	A	A	A
Sodium Phosphate	5%—Room Temp.	A	A	A
Sodium Sulphate	5%—Room Temp.	A	A	A
Sodium Sulphate	Con., Room Temp.	B	C	C
Sodium Sulphide	Con., Room Temp.	A	A	A
Sodium Sulphite	5%—Room Temp.	A	B	B
Stannous Chloride	5%—Room Temp.	B	C	C
Stannic Chloride	5%—Room Temp.	C	C	C
Zinc Chloride	5%—Room Temp.	B	B	C
Zinc Chloride	5%—Boiling Point	B	C	C
Zinc Sulphate	5%—Room Temp.	A	A	A

MISCELLANEOUS

Chemical	*Conditions*	*No. 302*	*No. 430*	*No. 410*
Alcohol, Ethyl	Room Temp.	A	A	A
Alcohol, Methyl	Room Temp.	A	A	A
Aniline	Room Temp.	A	A	A
Beer	Room Temp.	A	A	A
Benzene	Room Temp.	A	A	A
Buttermilk	Room Temp.	A	A	A
Carbonated Beverages	.....	A	A	A
Coffee	Boiling Point	A	A	A
Cider	.....	A	A	A
Ether	.....	A	A	A
Food Products	.....	A	A	A
Formaldehyde	.....	A	A	A
Fruit Juices	.....	A	A	A
Glycerin	.....	A	A	A
Linseed Oil	Hot	A	A	B
Meats	.....	A	A	A
Milk	Pasteurizing Cycle	A	A	A
Vegetable Juices	Hot	A	A	A
Vinegar	.....	A	A	A
Vinegar and Salt	Hot	A	A	B
Wet Coal or Cinders	.....	A	A	A

MACHINING

High chromium steels have the property of galling or seizing when under high pressure. The chips removed in machining exert a tremendous pressure on the nose of the tool, and therefore, tend to weld fast, producing a built-up edge. This action causes the tools to run hot, slows down the job and seriously interferes with the finish.

Chromium-nickel stainless steels give trouble from the galling of chips and in addition work harden rapidly. The tool in passing over the work will harden the surface and thus interfere with the next cut. This is particularly noticeable in milling and drilling operations where fine cuts follow each other in rapid succession. The only remedy for this is to reduce the speed, increase the feed somewhat and keep cutting. The tool must not be allowed to idle in the cut and glaze the work. It should be remembered, however, that the severe cutting conditions have been alleviated to a great extent by the introduction of "free-machining" grades. The improvement in cutting qualities is usually obtained by the addition of sulphur to the straight chromium grades and of selenium, zirconium or molybdenum to the chromium-nickel grades.

So much depends on the particular part under consideration, upon the facilities available, and upon the finish desired that any recommendations must be general and conservative as to speeds. This should be borne in mind in using the following data.

TURNING

For the more commonly used straight chromium steels, 50 to 70 surface ft. per min. is a fair average; for the chrome-nickel steels, 30 to 45 ft. per min. Experience indicates that for the free machining grades, these speeds can, in general, be safely doubled.

The best mechanical remedy to overcome galling of chips is to grind the tools with a steep top rake or lip angle. For turning tools, 20 to 22 deg. top rake is not too much for the chromium-nickel grades. The steep angle causes chips to skid off the nose of the tool and makes for much cleaner cutting. It is also helpful to stone the top of the tool.

High sulphur base lard oils (approximately 1 lb. of sulphur to a gallon) are widely used. Tool upkeep on the ordinary machining operation will be likely to run two to three times that for ordinary mild steel. Despite the difficulty of machining, many fabricators are successfully handling stainless steels on automatic machines. For such work, these steels machine best when the hardness is between 200 and 240 Brinell.

DRILLING

Drilling can best be done on the straight chromium grades with standard drills driven at about half the speed used for mild steel. For the chromium-nickel grades, galling can be relieved by using a drill having a short twist. Some tool companies make "slate drills" which have almost twice the twist angle of an ordinary twist drill. Laying out should be done with a triangular-nose center punch, taking care not to mark deeper than necessary.

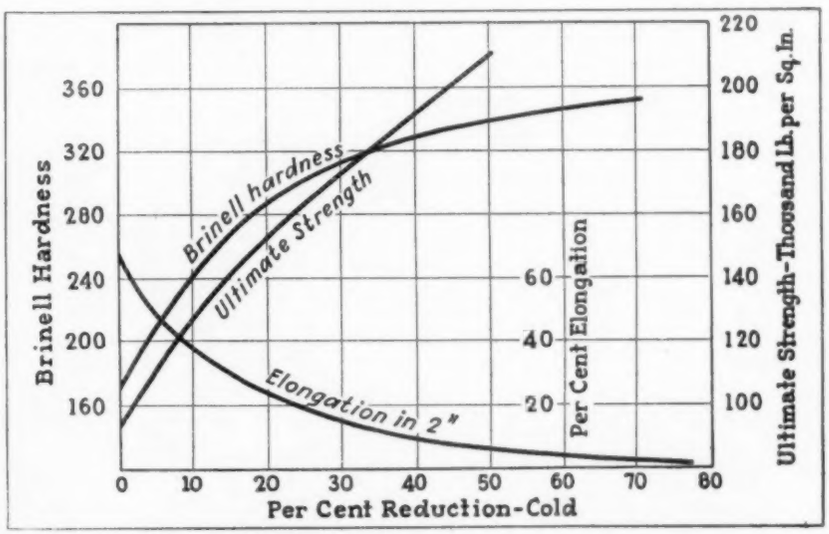
Because these steels work harden, it is necessary to exert enough pressure to keep the drill feeding. The metal should be backed up to permit the drill to cut all the way through without pushing the steel away from the drill point; otherwise the drill will become very hot and the tip burned. A cast iron backing plate is satisfactory. Immersing the tool in water after each cut will considerably increase its life. Good commercial grades of soluble cutting oils with the addition of sulphur have given satisfactory results. Turpentine added to a high sulphur base oil is valuable for deep hole drilling.

THREADING AND TAPPING

For threading, tools similar to those for threading soft brass should be used. For tapping, a tap used for dead soft brass with slightly more taper and having only two or three full teeth works best. Experience indicates that the following speeds are typical for tapping: for the straight chrome steels, about 15 surface ft. per min., and for the chrome-nickel varieties, about 9 to 10 surface ft. per min. With the free-machining grades an increase of about 50 per cent is a conservative figure. Use a good commercial grade of soluble oil with sulphur added. On tough jobs a paste made of white lead and a high sulphur base lard oil is effective. High-speed taps (collapsible where possible) are suggested. Self-opening dies are recommended for threading.

SAWING

For straight chromium grades, methods used on ordinary 0.30-0.40 carbon steels are satisfactory. On chromium-nickel grades high-speed hack-saws with heavy teeth and ample rake give the best results. For sawing comparatively light gages, 32 teeth per in. are about right. Blades with fewer teeth will be found better on heavy material such as bars. A heavily weighted saw, run at a slow speed, should be set to cut on the first stroke. Circular saws should operate at constant pressure against the metal.



Influence of Cold Work on a typical 18-8 stainless steel containing C-0.11; Cr.-18.47; Ni-8.20. Stainless steels of lower carbon content will work harden more rapidly, and with slightly higher carbon, the rate will be less

GRINDING, POLISHING AND BUFFING

Stainless steel is hard, abrasion resistant and has a low thermal conductivity. These properties make the procedure in grinding or polishing different from that employed for other metals.

Hardness and abrasion resistance decrease the rate of metal removal. Grinders or polishers often make the mistake of attempting to speed things up by an increase in pressure. This practice causes overheating with subsequent warping and burning or discoloration of the metal. The low thermal conductivity of stainless steels necessitates caution to prevent overheating of the metal in the portion being worked upon.

GRINDING

Grinding machinery, wheels and other equipment must be in good condition for best results. Machines should be selected which are rigidly constructed to prevent vibration. When portable equipment is employed, it should be electrically or pneumatically operated and be designed so the ventilating air stream is thrown away from the operator.

In general, high-speed equipment is more efficient than low-speed equipment on stainless steel. Low speed wheels should operate at about 5,500 surface ft. per min. while the high speed is about 9,500 surface ft. per min.

A grit size of 60 to 80 produces the roughest finish necessary and is usually selected for the first cut. The grain should be rather "soft" to prevent burning and still permit rapid removal of the metal. Where a better rough finish is desired, wheels 3 to 8 in. in diameter with an 80 to 100 grit size can be used. Chromium-nickel stainless steels should be ground with a porous wheel so particles of grit will break off before they become too dull. A harder wheel, with closer spacing of particles, can be used on the straight chromium types.

On each change of grit size, direction of grinding should be changed, if possible. Another point to bear in mind is to remove completely the larger particles of grit adhering to the surface before starting with the smaller size abrasive.

A water spray may be placed on the opposite side of the sheet or plate to cool the metal while it is being ground. In some cases, it is desirable to employ a protective coating of shellac, manila paper, or commercial compounds to protect the base metal outside the area being ground from flying particles.

POLISHING

As in grinding, the toughness of the metal necessitates a slow rate of removal. Carbon steel or brass contamination may cause corrosion, so polishing wheels or cloth used on ordinary steels or brass should be completely re-dressed before use on stainless. Selection of the first abrasive depends entirely on the degree of fineness to which rough grinding has been carried. Begin with a grit that is coarse enough to reach the bottoms of pits and scratches. For cold-rolled sheets, a No. 80 grit is usually coarse enough, though some operators have successfully substituted a No. 100 grit for this step. Rough polish until all pits, scratches and all other surface blemishes have been removed. Follow the No. 100 grit with a carbon oil grind using No. 120 grit.

If a Tampico finish is desired, the No. 120 grit wheel is followed with a slow-speed Tampico brush. Pastes recommended by abrasive manufacturers should be used in this operation.

A No. 4 standard polish finish can be obtained with a No. 120 grit aluminum oxide abrasive on a soft muslin wheel, operating at a surface speed of 6,000-8,000 ft. per min. For higher lusters, instructions from polish and abrasive makers should be followed.

BUFFING

In polishing, the abrasive is glued on and forms part of the wheel; in buffing, the wheel is usually made up of layers of cloth, paper or sheepskin disks with the abrasive applied with a binder or from an abrasive stick. Where a particularly shiny surface is desired, two operations are employed. The first uses a very fine abrasive buffing compound on the wheel. This is followed by a clean cloth wheel with no additional compound or only a fine dry powder such as levigated alumina, green chromic oxide or talc. Sulphur-containing buffing compound should be avoided.

With the proper wheel and speed, this operation may be completed in from three to seven passes across a pedestal buffing wheel. A hand buffing wheel can be used with sufficient pressure and speed to remove the gray color of cold-rolled stock.

SUGGESTED GRINDING AND POLISHING PROCEDURE

Operation	Abrasive	Grit No.	Type of Wheel	Surface Speed Ft. Per Min.	Wheel Diam.	Rev. Per Min.	Grease	Finish
Rough-Grinding	Aluminum Oxide	60–80	Muslin	6,500–9,500	6"	4,140–6,050	No	
Finish-Grinding	Aluminum Oxide	80–100	Muslin	9,000–9,500	6"	5,730–6,050	Yes	
Polishing	Aluminum Oxide	120	Soft Muslin	6,000–8,000	6"	3,820–5,090	Yes	No. 4
	Pumice & Lime	Pumice & lime in oil and kerosene	Tampico Brush	6,000–7,000	12"	1,900–2,250	Yes	No. 6
	Aluminum Oxide	180*	Soft Muslin	6,000–8,000	8"	2,860–3,820	Yes	No. 7
	Aluminum Oxide	220–380*	Soft Muslin	6,000–8,000	8"	2,860–3,820	Yes	No. 8
Buffing								
Cutting Down	Stainless Buffing Compound		Unbleached Muslin	6,000–8,000	8"	2,860–3,820		
Color Buffing	Stainless Buffing Compound		Unbleached Muslin	6,000–8,000	8"	2,860–3,820		

COLD WORKING

SPINNING

Stainless steels are more difficult to spin than copper, aluminum and brass. Speeds should be cut down from a half to a quarter of that used for copper. Greater power is required, and many spinning lathes will not have a large enough belt area to carry the load. White lead and linseed oil mixed to a consistency of a medium bodied paste gives best results. A good type of spinning tool is hardened steel of about the design used in spinning copper except that the tool should be slightly flatter to present a greater bearing surface.

While stainless steels have high ductility, it is not possible to spin them in one operation to anything like the depth to which copper is spun. Because of cold working, it will be found necessary to anneal at more frequent intervals. Before annealing the article should be thoroughly cleaned and degreased. After annealing, it should be pickled. In many cases it will be found necessary to change the contour of the spinning form in order to produce in the steel a duplicate of the piece in copper. Care should be taken that the spinning operation is not carried too far before annealing or the strain set up by cold working may be great enough to cause a crack.

RIVETING

Low carbon grades of stainless steel may be successfully riveted, but differences in procedure from that used on ordinary mild steel are necessary. Rivets for hot driving should have cone heads, and for cold driving, button heads. Rivets $\frac{1}{2}$ in. diameter and larger should have a $\frac{1}{16}$-in. fillet under the manufactured head. Rivet holes may be drilled or punched, the former being recommended. If punched, the holes should be reamed to remove distorted metal with $\frac{1}{16}$ in. for clearance. Holes in plates $\frac{1}{4}$ in. and thicker should be chamfered or countersunk at about 45 deg.

Rivets should be heated in a electric or muffle furnace with pyrometer control. Holding at temperature longer than 10 min. for austenitic steel or 30 min. for ferritic or martensitic steels is undesirable. Overheated rivets should be discarded. Driving may be done with hydraulic riveters or pneumatic hand riveters, the former being preferred. With pneumatic riveters, higher air pressures will be required than for carbon steels, 90 lb. or higher being desirable. Edges of plates where possible should be planed to a bevel of 20-25 deg. for thicknesses of $\frac{1}{2}$ in. and under for a caulking edge. For plates heavier than $\frac{1}{2}$ in., the angle should be 15 deg.

SHEARING

Stainless steels require for shearing about twice the amount of power used for mild steel. Shear knives must be sharp and closely adjusted, especially for the chromium-nickel grades where the metal will be drawn over the bottom knife and work hardened before cutting actually begins. In any case, a certain amount of shearing strain is unavoidable.

The straight chromium steels, like mild steels, have a tendency to break after being cut through 50 to 75 per cent of the cross section. The chromium-nickel grades differ in that they must be cut all the way through.

BLANKING AND PUNCHING

Straight chromium steels can be handled by the same general practice used for mild steel. Since they are stronger than mild steels, heavier backing for dies and more power are required. Otherwise, punches may be set with the same clearances used in ordinary practice.

For the chromium-nickel grades, it is necessary to keep down the clearance between punch and die, regardless of the thickness of the material. If the clearance is great, the steel will be drawn over the edge, work hardened and bring excessive strain on the tools and the machine. Standard punches and dies for use on steel can be used only for the lighter gages below No. 20. For heavier gages, special punches with a neat fit are necessary.

Gang punches are difficult to operate because it is difficult to maintain the proper clearance. This operation can be carried out, however, if the tools are in good condition and held to a close adjustment. "Stripper" attachments should be heavier than used for ordinary steel.

FORMING AND DRAWING

When fully annealed most chromium steels, excepting the heat-resisting grades having a chromium content over 23 per cent, can be formed and drawn successfully. The heat-resisting grades are not well suited for deep drawing operations since they do not posses the desired ductility. However, simple shapes requiring shallow draws and bends may be made.

The more ductile grades cold work to a greater extent than ordinary deep drawing steel and have greater strength. Hence they require heavier backing and deeper die sections. For the chromium-nickel grades, it is necessary to use a lubricant with a heavy body to stand up under the high temperatures and pressures encountered. For heavy gage material a good drawing compound is white lead thinned down with linseed oil to about the consistency of 600W engine oil. Most standard drawing compounds will be satisfactory provided they are mixed to the proper consistency which is about that indicated for white lead.

The slower the press speed, the less work hardening will result, and the deeper the draw that can be made in one operation. Slow drawing speeds are always preferable, but in the work hardening grades they are even more important. A greater clearance can be used between the punch and the die than with mild steel, which is just the reverse of the case in shearing, blanking and punching. A large radius on the draw ring is desirable.

Adjustment of the machine and the die set is of vital importance. Rough dies frequently cause unsatisfactory results. Use of a drawing compound not sufficiently heavy results in "wiring" the dies, breaking the piece and making stoning necessary before the dies can be used again.

Before drawn parts are annealed they should be throughly free from all grease. Otherwise splitting and carburization of the surface will lessen its corrosion resistance. Among the cleaners that can be used successfully is sodium meta-silicate at a temperature of 160 to 200 F. Strength of the solution depends on the kind and amount of drawing compound on the work. Electrolytic cleaning can also be used.

PROPERTIES OF SOME

Type Number	410	416 §	430	446
APPROXIMATE CHEMICAL COMPOSITION	C .12% Max. Mn .50% Max. Si .50% Max. S and P .03% Max. Cr 10.0-13.5%	C .12% Max. Mn .50% Max. Si .50% Max. S .20-.40% P .03% Max. Cr 12-14% Mo .45-.60%	C .12% Max. Mn .50% Max. Si .50% Max. S and P .03% Max. Cr 14-18%	C .20% Max. Mn .50% Max. Si .50% Max. S and P .03% Max. Cr 23-30%
PHYSICAL PROPERTIES				
Density				
gm./cm.³	7.75	7.73	7.70	7.60
lb./in.³	.279	.278	.277	.274
Modulus of Elasticity, 10^6 lb./sq. in.	28	28	29	29
Structure	Ferritic,Martensitic	Ferritic,Martensitic	Ferritic	Ferritic
SpecificHeat,B.t.u./°F./lb. 0-200° F.	.154	.154	.152	.144
SpecificHeat,Cal./°C./gm. 0-100° C.	.154	.154	.152	.144
Thermal Conductivity, B.t.u./sq. ft./hr./°F./in.				
200° F.	160	160	156	140
1000° F.	184	183	170	162
Linear Coefficient of Thermal Expansion, per °F. × 10^{-6}				
0-200° F.	5.7	5.7	5.4	5.3
0-600° F.	6.1	6.1	5.6	5.5
0-1000° F.	6.7	6.7	6.1	6.0
0-1500° F.	7.0	7.0	6.3	6.2
Melting Point	2700-2750° F.	2700-2750° F.	2650-2700° F.	2650-2700° F.
ELECTRICAL PROPERTIES				
Magnetic Permeability in annealed state	Ferromagnetic	Ferromagnetic	Ferromagnetic	Ferromagnetic
Electrical Resistivity, microhms/in.³, 70° F.	22.5	22.7	23.5	26.5
NOMINAL VALUES OF MECHANICAL PROPERTIES				
Hardness				
Brinell number, Annealed	135-165	145-185	145-185	140-185
" " Heat-Treated	293-390	180-300	.....	.....
" " Cold Rolled	.....	.....	185-270	.....
Rockwell number, Annealed	75-85B	80-90B	80-90B	78-90B
" " Heat-Treated	30-40C	10-30C	.....	.....
" " Cold Rolled	.....	.....	90-105B	.....
Ultimate Tensile Strength, lbs./sq. in., Annealed	65,000-85,000	70,000-85,000	70,000-90,000	75,000-95,000
" " " Heat-Treated	100,000-200,000	80,000-160,000	.....	.....
" " " Cold Rolled	.....	.....	90,000-130,000	.....
Yield Point, lbs./sq. in., Annealed	35,000-45,000	40,000-50,000	40,000-55,000	45,000-60,000
" " " Heat-Treated	60,000-180,000	60,000-130,000	.....	.....
" " " Cold Rolled	.....	.....	65,000-130,000	.....
Elongation in 2 in., Annealed	35-25%	35-25%	30-20%	30-20%
" " " Heat-Treated	25-10%	25-15%	.....	.....
" " " Cold Rolled	.....	.....	20-2%	.....
Reduction of Area, Annealed	65-60%	65-60%	55-40%	50-40%
" " " Heat-Treated	60-25%	60-40%	.....	.....
Impact Strength Izod value, ft. lbs., Annealed	100-60	100-60	60-5	.....
" " " " Heat-Treated	100-5	100-10	.....	.....
HEAT-TREATMENT Annealing	Furnace cool from 1650° F. to 1100° F. or Air cool from 1350° F. – 1400° F.	Furnace cool from 1650° F. to 1100° F. or Air cool from 1400° F. – 1450° F.	Air cool from 1400° F. – 1500° F.	Air cool from 1450° F. – 1550° F.
Hardening	Quench from 1750° F. – 1825° F.	Quench from 1750° F. – 1825° F.	Non-hardening	Non-hardening
Tempering	Draw at 400° F. – 1300° F.	Draw at 400° F. – 1300° F.	Non-hardening	Non-hardening
Forging	Start at 2100° F., Finish at 1500° F.	Start at 2100° F., Finish at 1500° F. See Footnote	Start at 1950° F., Finish at 1400° F.	Start at 2000° F., Finish at 1400° F.
HEAT-RESISTANCE Scaling Temperature				
Continuous service	1250° F.	1250° F.	1500° F.	1900° F.
Intermittent service	1400° F.	1400° F.	1600° F.	2000° F.
WELDING PROPERTIES	Fair—brittle welds. Can be annealed.	Poor—brittle welds. Likely to crack. Not recommended.	Fair—brittle welds. Slight response to anneal.	Fair—brittle welds. Slight response to anneal.
MACHINING PROPERTIES	Fair.	Good. About 80-85% compared to screw stock.	Fair.	Fair.
DRAWING or STAMPING	Fair.	Poor.	Good.	Poor.

§ This analysis is designed for machining applications, and is not recommended for forging operations requiring severe deformation.

TYPICAL STAINLESS STEELS

302 *	303 §	345	316	309	310
C Over .08-.20% Mn .60% Max. Si .75% Max. S and P .03% Max. Cr 17.5-19% Ni 8.0-9.5%	C .20% Max. Mn 1.25% Max. Si .75% Max. S .03% Max. P .16% Max. Cr 17.5-19% Ni 8.0-9.5% Se .07 Min.	C .10% Max. Mn .75% Max. Si .75% Max. S and P .03% Max. Cr 17-20% Ni 8-12% Cb 10 times C	C .10% Max. Mn 1.50% Max. Si .75% Max. S and P .03% Max. Cr 16-19% Ni 9-14% Mo 2-4%	C .20% Max. Mn 1.50% Max. Si 2.00% Max. S and P .03% Max. Cr 22-26% Ni 12-14%	C .25% Max. Mn 1.50% Max. Si 2.00% Max. S and P .03% Max. Cr 24-26% Ni 19-21%
7.93 .286 29 Austenitic .118 .118	7.93 .286 29 Austenitic .118 .118	7.98 .288 29 Austenitic .118 .118	7.98 .288 28.5 Austenitic .118 .118	7.98 .284 30 Austenitic .118 .118	7.98 .288 30.5 Austenitic .118 .118
110 150	110 148	110 150	108 147	92.5 113	....
9.0 9.5 10.1 11.1 2550-2600° F.	9.0 9.5 10.1 11.1 2550-2600° F.	8.8 9.4 10.2 11.3 2550-2600° F.	8.4 9.0 9.7 11.0 2500-2550° F.	8.0 8.6 9.5 10.8 2500-2550° F.	8.0 8.5 9.4 10.0 2500-2600° F.
Non-Magnetic μ = 1.003 27.6	Non-Magnetic μ = 1.003 27.6	Non-Magnetic μ = 1.001 28.0	Non-Magnetic μ = 1.003 28.5	Non-Magnetic μ = 1.003 30.0	Non-Magnetic μ = 1.001 30.5
135-185 180-330	130-150	135-185	135-185 180-300	140-185	145-210 ....
75-90B 10-35C	72-80B	70-90B	70-90B 10-30C	78-90B	80-95B ....
80,000-90,000 100,000-180,000	80,000-90,000	80,000-90,000	80,000-90,000 100,000-150,000	90,000-110,000	90,000-110,000 ....
35,000-45,000 50,000-150,000	35,000-45,000	35,000-45,000	35,000-55,000 50,000-125,000	40,000-60,000	40,000-60,000 ....
60-55% 50-10%	60-50%	60-55%	70-60% 50-15%	65-50%	55-45% ....
65-55%	70-55%	65-55%	75-60%	65-50%	60-50% .....
110-70	110-70	....	120-70	....	....
Quench from 1850° F. – 1950° F.	Quench from 1950° F.	Quench from 1950° F. – 2050° F.	Quench from 1950° F. – 2050° F.	Quench from 1900° F. – 2050° F.	Quench from 1900° F. – 2050° F.
Non-hardening	Non-hardening	Non-hardening	Non-hardening	Non-hardening	Non-hardening
Non-hardening	Non-hardening	Non-hardening	Non-hardening	Non-hardening	Non-hardening
Start at 2100° F., Finish over 1700° F.	Start at 2100° F., Finish over 1700° F. See Footnote	Start at 2250° F., Finish over 1800° F.	Start at 2200° F., Finish over 1700° F.	Start at 2150° F., Finish over 1800° F.	Start at 2150° F., Finish over 1800° F.
1600° F. 1450° F.	1600° F. 1450° F.	1600° F. 1450° F.	1650° F. 1500° F.	2000° F. 1800° F.	2000° F. 1900° F.
Very good—tough welds.	Fairly good. May crack. Not recommended.	Very good.	Very good.	Good.	Good.
Fair—tough.	Good. About 65% of screw stock.	Fair—tough.	Fair—tough.	Fair—tough.	Fair—tough.
Very good.	Fairly good.	Good.	Good.	Good.	Good.

* These data apply also to modifications of this analysis.

§ This analysis is designed for machining applications, and is not recommended for forging operations requiring severe deformation.

SOLDERING, FORGING, BRAZING

SOFT SOLDERING

Stainless steels can be soldered if precautions are taken to get proper penetration. In the polished condition, they are resistant to hydrochloric acid which is the base of most soldering fluxes. There are a number of special fluxes on the market; good results are obtained by the use of an uncut hydrochloric acid allowing the acid to remain at least one minute on the surface of the metal. After the surface has been etched, satisfactory results may be obtained by the use of the regular cut acids. Better results, however, are obtained by the use of a good soldering salt. Since these steels have a lower thermal conductivity than wrought iron, use a larger iron than would be used when soldering steel, copper and other metals having considerably higher thermal conductivity. A little longer time is required to bring the metal up to soldering temperature. Care should be taken not to have the solder too hot, as embrittlement is likely to occur.

These steels in sheet form are likely to buckle when soldered because of the high coefficient of expansion, about 1½ times that of mild steel. To prevent buckling it is sometimes necessary to use chill plates, preferably of copper, which will keep the temperature from extending over the surface of the sheet. Immediately after soldering, it is necessary to inhibit further action by washing thoroughly with amonia water or with water in which a liberal amount of yellow laundry soap and ordinary soda has been dissolved.

It is desirable not to depend on the solder for anything except a tight joint. Generally speaking soldering should be avoided, but where necessary, it is best to obtain the required strength of the joint by riveting or spot welding. In most cases locked seamed and soldered joints do not remain tight over a long period of time because it is generally impossible to have the locked seamed joint itself perfectly tight.

SILVER SOLDERING

Stainless steels are really silver soldered, either steel to steel or steel to copper. A flux made up of potassium acid-fleuoride and borax works well, and the manufacturers of silver solders have developed various fluxes for the different types of solders. In silver soldering copper to these alloys, direct the flame only on the copper and get the heat into the joint by conduction. It requires greater skill on the part of the operator to silver solder steel to steel. Preheating to a slight extent in areas immediately adjacent to the joint is advisable.

To remove the flux remaining on the steel after the soldering operation, a small high-pressure steam jet is recommended. Remove the flux immediately after the soldering is done.

In soldering stainless steels with the lower percentages of straight chromium, a solder should be used with a melting point sufficiently low so the operation can be carried out below 1500 F. When heated above this temperature and rapidly cooled, these steels will harden.

FORGING

If the precautions usualiy taken in forging high carbon steels are observed, little difficulty will be encountered in forging stainless. The austenitic chrome-nickel steels are stronger at high temperatures than ordinary steels and are somewhat harder to work. The forging operation may be conducted down to about 1700 F. before reheating unless high physical properties are required. If forging is done below this temperature reduction should be small so as not to rupture the work. These steels should be heated uniformly to a temperature between 2100 and 2250 F. depending on composition.

The chromium stainless steels may be forged at a temperature down to 1500 F. without danger of splitting. If the forging is carried below 1600 F. these steels stiffen considerably and may crack if forged with heavy blows.

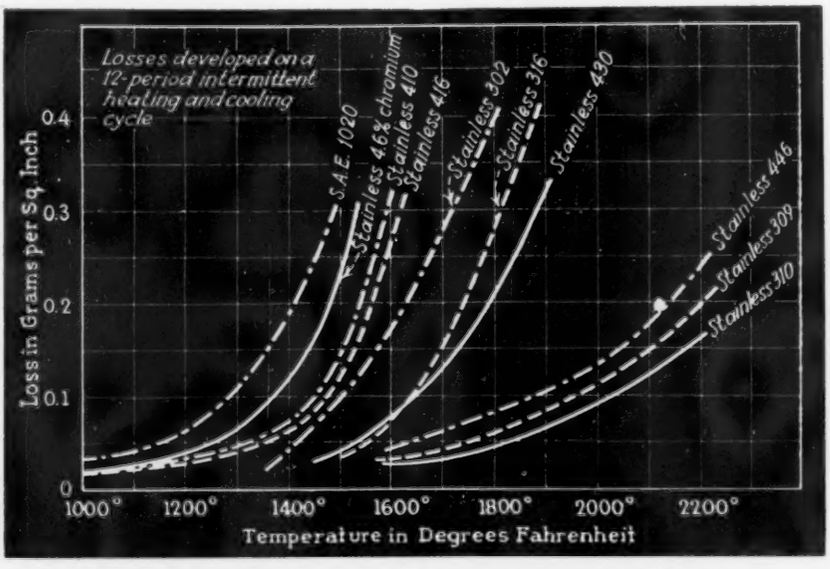
The chromium steels, particularly in the hardened condition, should be slowly and uniformly heated to the forging temperature or rupture is likely to occur in heating. Forged bars that have been allowed to cool to room temperature, but have not been annealed, should not be placed in a furnace which is above 600 F., especially if the forging is of irregular cross-section. Special precautions should be taken to cool the forged part.

These steels should be heated to a temperature between 1900 and 2200 F. depending on the composition.

If it is desired to pickle any finished forging or semi-finished forging of the martensitic chrome steel, the forging should be annealed prior to the pickling operation. If forgings are pickled in the hardened condition, surface cracks will almost invariably develop.

BRAZING

Brazing of stainless steel is not recommended as a marked decrease in corrosion resistance and embrittlement is likely to occur.



Scale resistance of some stainless steels compared to S.A.E. 1020

WELDING OF STAINLESS STEELS

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To weld the stainless alloys, an understanding of the characteristics of these metals is needed as compared with mild steel—an item with which most fabricators are familiar. First, the stainless grades have considerably less heat conductivity and higher electrical resistance. The resistance to oxidation at high temperatures is much greater; however, the melting point is lower. From this it can be readily seen that stainless will require less heat to perform the actual welding operation. Second, the straight chromes have a lower coefficient of expansion but the chrome-nickels have a much higher coefficient of expansion, and it will be found necessary to take this into consideration to prevent excessive warpage in the finished job. Fixtures to hold the work in the lighter gages are frequently the answer.

STRAIGHT CHROMIUM STEELS

The straight chromium types all produce welds that are brittle and subsequent annealing does not improve ductility to any great extent. On those jobs where it is possible to peen the weld while still hot, the ductility is raised, and if followed by an anneal, it is improved decidedly. When welding a straight chromium vessel, it is well to work out design so as to place the welds where they will not be stressed.

The chromium-nickel types are ductile in the welded condition. They are readily welded and the largest factor to contend with here is their high coefficient of expansion which if not properly taken care of will give trouble due to warpage. This can be readily overcome by proper fixtures in the lighter gages and by the procedure of welding operations on the heavier gages. Control of expansion and contraction is pretty well understood by most welders and it can be stated that on the stainless material the use of less heat assists to no small extent.

On the straight chromium steels, make ready the seam to be joined, spacing approximately the thickness of the gage on light materials. On the heavier gages the edges should be scarfed the same as for mild steel. Tack-weld at intervals—say approximately every 4 to 6 in. Closer spacing is essential for thicknesses under $\frac{1}{8}$ in., using a chromium-nickel type of electrode. Then finish weld, using electrodes of analysis similar to the base metal. If possible, peen each bead of weld metal to increase ductility. Some extreme cases, where the vessel will contain a corrosive solution, annealing is necessary, however, for high temperature and ordinary corrosive conditions, it is not needed.

CHROMIUM-NICKEL STEELS

The chrome-nickel types present a somewhat different welding picture. Here we have three factors: low heat conductivity, high electrical resistance, and coefficient of expansion. On the lighter gages, fixtures to hold the work are essential to carry away the heat and reduce tendency to warpage. Space and tack as recommended for chrome types, and finish weld with same analysis electrode as base metal. The high coefficient of expansion can be well controlled in the heavier gages by procedure without the use of fixtures. The actual welding operation should be done with just sufficient heat to make the weld. From thickness 0.080 in. and over, it is better to weld from both sides using a smaller electrode than normally used for mild steel. For welds on heavier gages requiring scarfing before welding, string beads should be used, a 1-in. plate requiring eleven to thirteen passes to complete. It is essential that slag be removed before each pass. This holds good for both types of stainless steel.

OXYACETYLENE WELDS

Oxyacetylene welding is not generally used for gages heavier than 1/16 in. and here again fixtures are an essential requirement except on those jobs so shaped that heat will not cause excessive warpage. Oxyacetylene welding is accomplished by the proper adjustment of the flame and the use of a good stainless steel gas welding flux. The seam should be tacked at closer intervals than used for electric arc welding and the flux applied on the reverse side from which the weld is made. The welding flame should be adjusted to show approximately 1/32 in. of excess acetylene on the welding cone. This adjustment will maintain a reducing atmosphere, thus preventing the chromium from burning out of the molten pool, and should never be in excess of 1/16 in. of acetylene feathers. Too much acetylene will carburize the weld and reduce its corrosion-resistance. The welding flame should be held close to the molten pool and proceed with little puddling. Filler rod (bare) should be added as needed and it should be kept in the flame so that it will not become oxidized. Here again the lower melting point of stainless is a factor and a smaller orifice tip will be required—say one or two sizes smaller than that required for the same gage of mild steel.

SPOT WELDING

Spot welding of stainless steel requires less heat than that used on mild steel of the same gage. This method is ideal for the assembly of many stainless articles from small ash trays to passenger trains. The question is often brought forward as to to eliminate the depression from this type of weld. This is a natural condition due to contraction and can be held to a minimum by using a large flat electrode on the face side of the work and the rounded and smaller electrode on the reverse side. Tube type heat control gives far better results than the manual type.

Seam and flash welding can also be readily performed on stainless steel assemblies, and the electrodes or dies should be made up of one of the new alloys now available that give longer life than copper which is soft and loses its shape quickly.

Because of the high strength of stainless steel at high temperatures, a change of design for the upsetting cam on automatic feed type of flash welders is required. The cam should be so adjusted to knit the parts together quickly when flash is correct, then to taper off the upsetting pressure more rapidly than that used for mild steels.

The atomic hydrogen process of welding—both hand and automatic—is being used. This method of welding is fast and gives good welds when properly set up and thus far has given a good account of itself in the automatic types.

WELDED JOINT DESIGNS

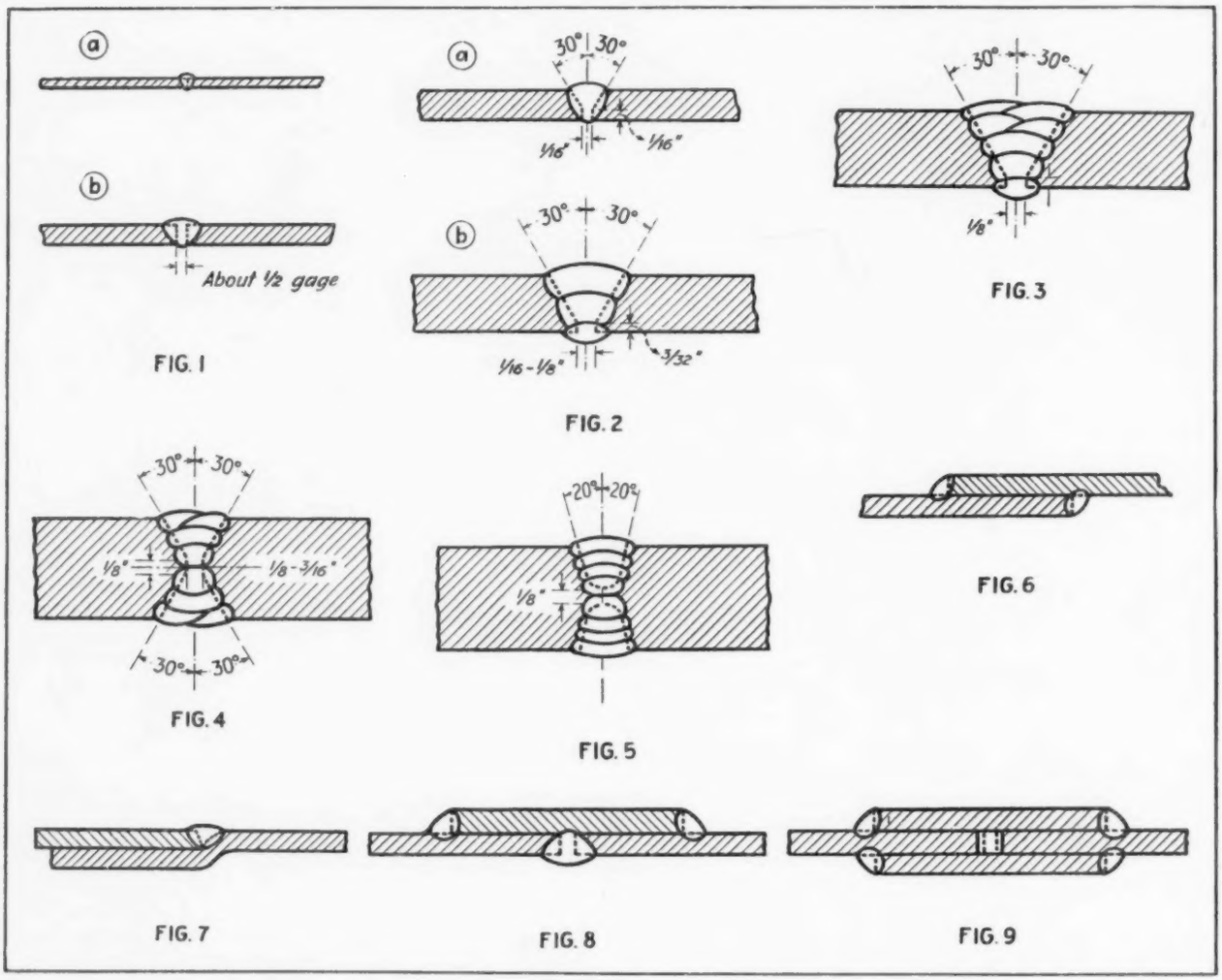


FIG. 1

FIG. 2

FIG. 3

FIG. 4

FIG. 5

FIG. 6

FIG. 7

FIG. 8

FIG. 9

Fig. 1—The closed butt joint (a) with one bead is suitable for No. 18 gage sheet and lighter. The open butt joint (b) is for gages Nos. 18-7.

Fig. 2—For heavier than No. 7 gage, the single V butt joint should be used. Here the edges to be welded are scarfed 30 deg. to within about $\frac{1}{16}$ in. of the bottom and set up for welding about $\frac{3}{32}$-$\frac{1}{8}$ in. apart; for plates up to $\frac{1}{4}$ in. thick, one bead is all that is required for good joints. For plates heavier than $\frac{1}{4}$ in. edges should always be scarfed, and two or more beads will be necessary to fill the V. Proper procedure is to fill the V with weld metal, then grind or chip out the groove on the other side, removing all slag, until solid clean metal is uncovered. Then the second bead is laid in the clean groove thus formed.

Fig. 3—Where the gage is heavier than $\frac{1}{2}$ in., the single V butt joint may still be used satisfactorily, but multiple beads will be required to fill the V. It is good practice, where multiple beads are to be laid down, to peen the first so as to expand the weld metal slightly, thus relieving any shrinkage strains that might have been set up during the cooling of the molten metal. In order that solid, clean, weld metal may be obtained, all slag oxide must be removed from each layer before putting down the next. A layer about $\frac{1}{4}$ in. thick can be deposited satisfactorily in one bead, which serves as a means of estimating the approximate number of beads required. After the V is filled, the groove on the opposite side should be chipped out to clean metal before laying in the final bead.

Figs. 4 and 5—For plates $\frac{3}{4}$ in. and heavier, the double V or U joint should be used. For heavy work the U groove is generally preferred as less current metal is cut away in forming the groove and less of the expensive weld metal will be required to fill the U than the V. In welding double V grooves, it is customary to separate the plate about 1/8-3/32 in. at the neck of the double V. The first bead is laid down from that side which is most convenient. This bead is then peened and slag cleaned off, after which the successive beads are laid down cleaning off slag in each case until the V is filled. The V on the opposite side is then chipped or ground out to clean metal and filled as described. With the double U joint, Fig. 5, it is customary to butt the plates close together, leaving no gap between them. The first bead is laid down, peened, clean of slag, and successive beads are laid in until the U is filled. The other side is then chipped or ground clean, and the U filled with successive beads.

Fig. 6, 7, 8 and 9—These lap and strap joints give extra strength. The joints in Figs. 8 and 9 are especially strong. The parent plates are welded and ground flush before the laps are welded.

FOR STAINLESS STEELS

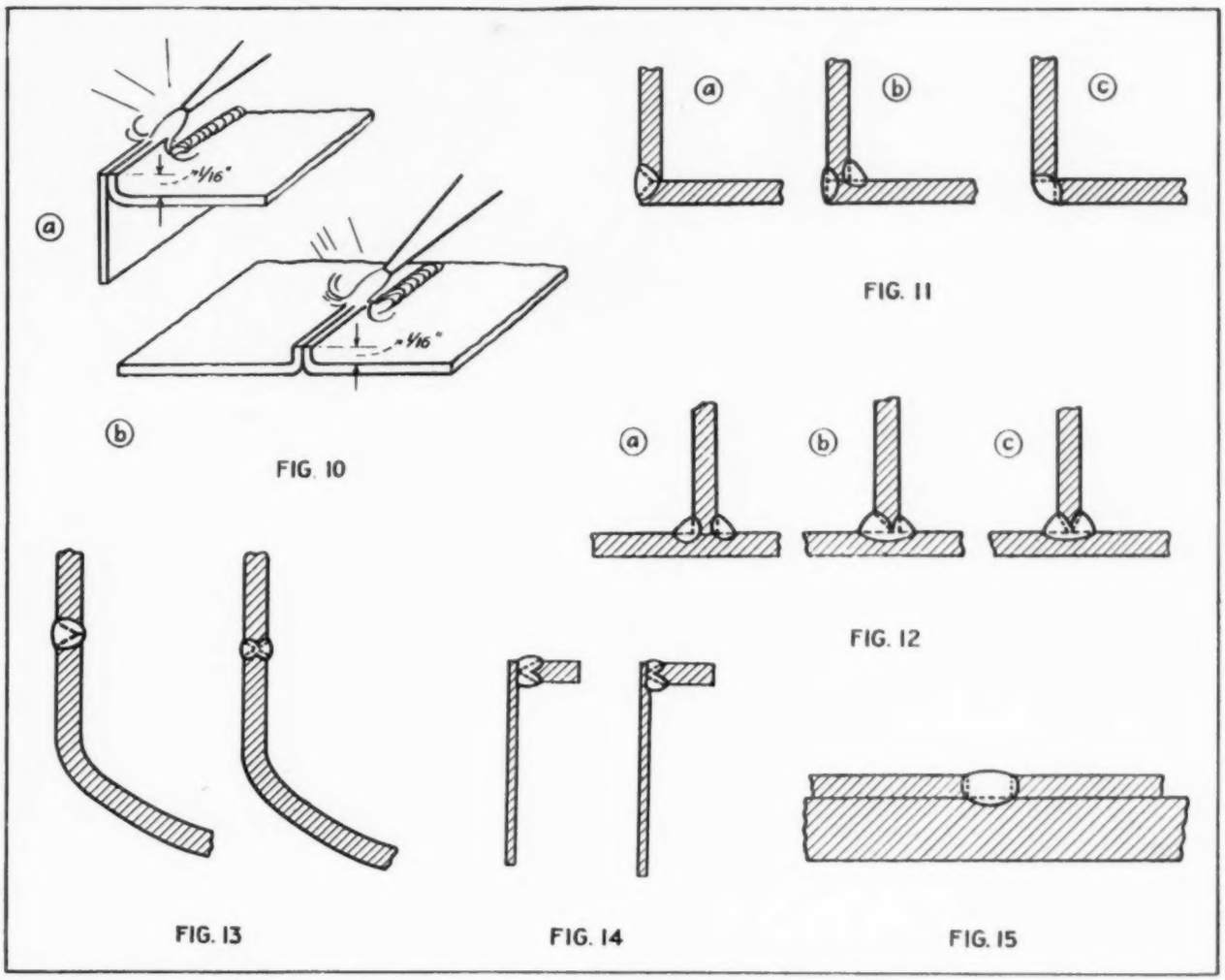


FIG. 10

FIG. 11

FIG. 12

FIG. 13

FIG. 14

FIG. 15

Fig. 10—The single (a) and the double (b) flanged joints are suitable for No. 16 gage and lighter strips and sheets. This joint is customarily made by acetylene, or atomic hydrogen, welds without the use of filler rod. It is not a desirable joint, however, where the weld is to be ground flush and polished because of the danger of cutting through the sheet.

Fig. 11—In making various types of corner joints, metal thickness determines whether or not the edges should be scarfed. The joint (b) illustrates the strongest of the three types. That shown at (c) is frequently, but improperly used for tank work. While lacking the strength of either (a) or (b), it presents a neater appearance in that the outside is easily ground and polished. If extra strength is desired and the gage permits, it may be welded on the inside also; but this it not altogether desirable as it is virtually impossible to grind and polish satisfactory.

Fig. 12—Various types of T joints are shown; (a) is suitable for light metal where scraping is unnecessary; (b) and (c) are suitable for joints in assemblies made from heavier gages.

Fig. 13—In the attachment of flanged, and flanged and dished, heads, for circular tanks and pressure vessels, either single V, double V or U joints may be used, depending on the heaviness of the gage. The weld in all such cases should be located at some distance from the corner in order that it may be ground flush, if necessary.

Fig. 14—In equipment where a tank or pressure vessel may require a removable cover or head some reinforcement at the edge will be necessary for holding bolts and studs. A flanged ring may be attached for this purpose. The ring may be made from flat bar stock rolled to circular shape or from an angle similarly rolled. In welding a lighter section to a heavier, it is highly important that a proper bond be obtained. To secure this, the welding must be so conducted that there will be ample penetration of the heavier section; otherwise the lighter section will merely be stuck to the heavier and likely to break away.

Fig. 15—Sometimes it is desirable to utilize corrosion-resisting alloys for lining heavy tanks and pressure vessels where the cost of solid stainless metal would be prohibitive. Light plates or sheets are attached to the heavy plates by "plug welds". The lining sheet is perforated by drilling or punching at frequent and regular intervals, and welded through the hole to the base plate. If the lining seat is light, the hole should be small and one weld as shown will be sufficient. With heavier linings a larger hole may be necessary with one weld circling the inside of the hole. A second weld may be necessary to cover any bare spot where the base plate is exposed.

HEAT-TREATMENT

of Straight Chromium Stainless Steels

HARDENING

Working characteristics of straight chromium stainless steels are quite different from those of the chromium-nickel stainless steels. The steels which contain up to 18 per cent chromium will harden when rapidly cooled from about 1,500 F. The steels having a chromium content below 15 per cent harden intensely when air cooled from a temperature above 1,500 F. and after this treatment they have a Brinell hardness as high as 400, depending upon the combination of carbon and chromium. Steels having a chromium content between 15 and 18 per cent harden to a lesser extent, but a Brinell hardness up to 300 may be readily obtained if the combination of carbon and chromium is right. The steels having a chromium content above 18 per cent are non-hardening or harden to a much less extent depending mainly on the carbon content.

On account of the air-hardening properties of steels, containing less than 15 per cent chromium, these steels when air cooled from about 1,500 F. are not in their best condition to resist shocks. For most applications, therefore, it is necessary to have these steels annealed or tempered.

Steels containing above 20 per cent chromium do not harden when rapidly cooled. Annealing has little effect upon their physical properties. These steels may be rendered brittle, if brittleness is judged by their ability to bend. The conditions which may produce brittleness are twofold. When slowly cooled from above 1,200 F., brittleness is produced. This brittleness, however, can be corrected by again heating temperatures above 1,200 F. and cooling rapidly through this range. Best toughening is produced by water quench.

Brittleness also results when the steels are heated for a long time above 1750 F. Definite grain growth occurs which renders these alloys brittle when cold. This condition cannot be corrected by heat treatment. Even though these steels may be embrittled by slow cooling or holding for a long time above 1750 F., they will resist ordinary handling when cold but should not be subjected to violent shock. These steels are usually used to resist oxidation at high temperatures. They remain quite ductile at such temperatures.

These chromium steels are about 50 per cent stronger than mild steels with about the same elongation of the best grade of deep drawing steels. In the fully annealed condition, they have a hardness of about 150 Brinell. Their melting point is only slightly less than that of mild steel.

Unlike the chromium-nickel stainless steels, these steels are stable over all temperature ranges. In welding operations, both the deposited weld metals and the metal adjacent to the weld are hardened by rapid cooling except when the chromium is more than 20 per cent and should be annealed. This is best accomplished by annealing the entire unit although on comparatively light gages, it is possible to local anneal with a blow torch between 1,300 and 1,450 F. but never above 1,450 F. Unless properly annealed or normalized failure is likely to occur as the hardened area will not have sufficient ductility to withstand violent shock.

While annealing removes the strains and restores a good measure of ductility, the weld itself will not be as ductile as the rolled section due to the difference in structure between the cast and rolled structure. When the chromium exceedes 20 per cent, the welded section is very little improved by annealing.

ANNEALING

Chromium stainless steels should be annealed after the welding operation.

1. Thoroughly remove all grease from the piece to be annealed.
2. Use a muffle or semi-muffle furnace.
3. Maintain a slightly reducing atmosphere.
4. Hold at temperature long enough to get entire section uniformly heated.
5. Slowly cool in furnace not more than 50 deg. per hour.
6. Never allow direct flame to come in contact with the work.

When the articles to be annealed can be cooled in air they should not be heated in excess of 1,400-1,500 F. This method of annealing will give almost as good results as heating to the higher temperatures and slowly cooling and has the advantage that steels annealed by this method are more easily pickled.

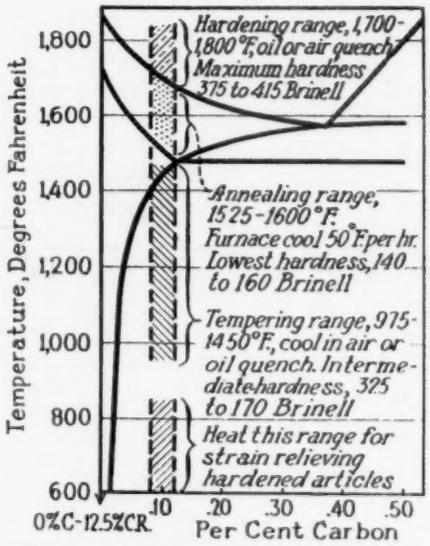
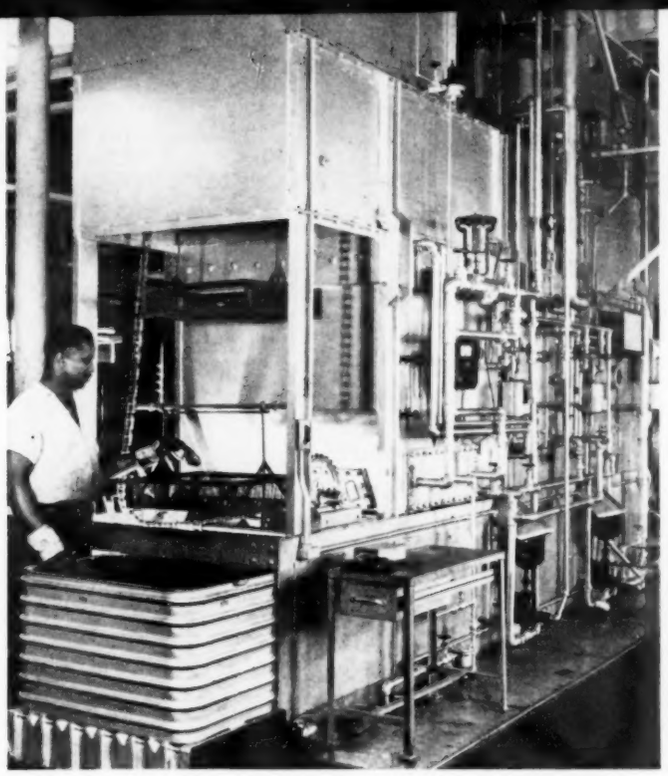


Diagram indicates temperature ranges for heat-treating a type of 410 stainless steel with 0.08-0.12 per cent carbon and approximately 12.5 per cent chromium

For annealing the chromium-nickel types, procedure outlined in 1 and 2 above should be followed. In addition:

3. Annealing temperatures of 1,850 to 2,000 F. should be used.
4. The time of annealing will depend on the temperature used and the section of the steel. The work should be brought to a temperature uniformly. Sections from $\frac{1}{8}$ to $\frac{1}{2}$ in. thick should be held at 1,850 for a half hour while at 1950 F. and above the time required is from three to five minutes.
5. Cool rapidly. Usually air cooling is sufficiently rapid although heavy sections ($\frac{1}{4}$ in. and heavier) may require an air blast, water quench or water spray. These steels should cool to below a red temperature in less than 3 min.
6. Never allow a direct flame to come in contact with the steel.
7. The oxide formed by annealing should be removed. This may be done either by sandblasting or pickling, preferably the latter. In sandblasting care should be exercised to eliminate iron particles in the blast which would tend to become embedded in the surface of the metal and cause corrosion.



Practically all parts to be plated first are sent through this conveyor-type vapor-dip-vapor degreaser for thorough cleaning. Very small parts are placed in small wire-mesh trays which are placed in the larger baskets.

Plating to Accurate Limits

Automatic current-density control and careful maintenance of the plating solution insure proper finishing of small parts

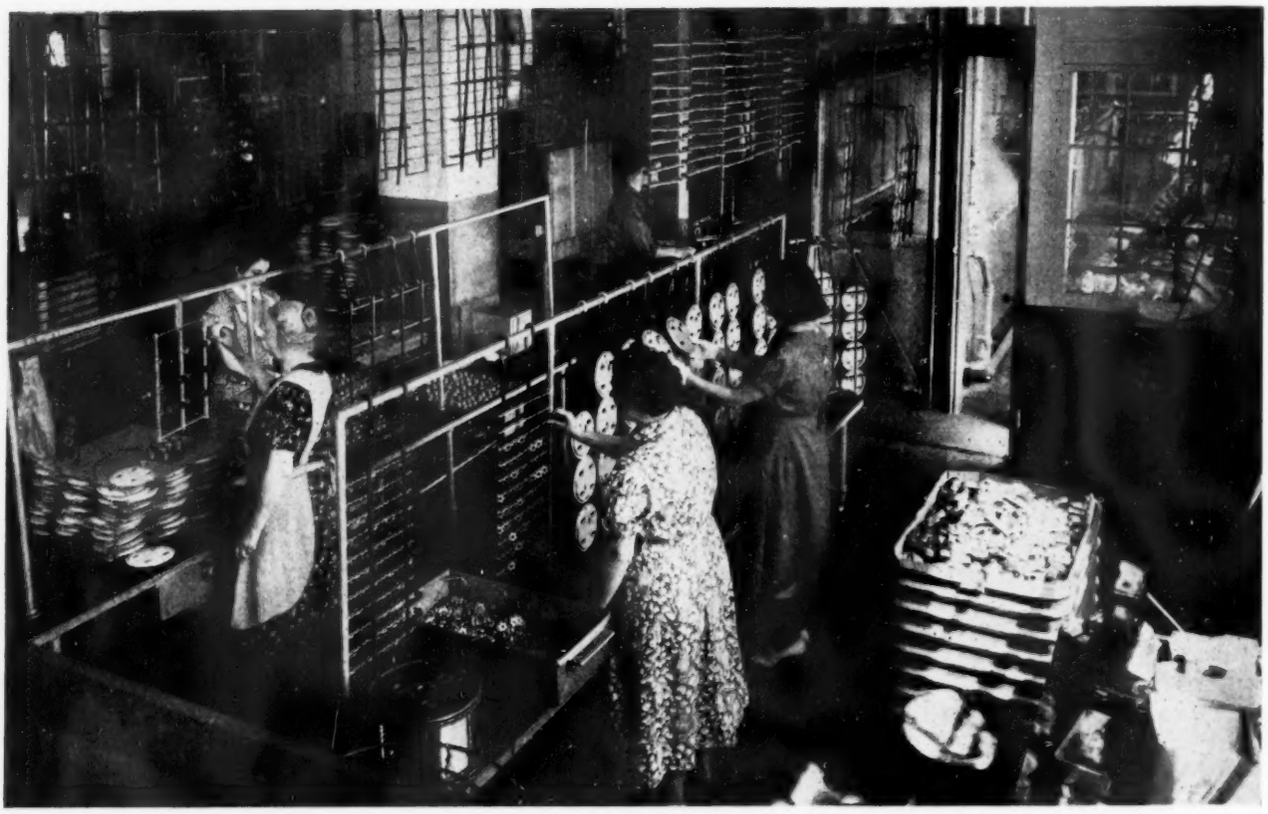
BEN C. BROSHEER
Assistant Editor, American Machinist

VARYING requirements for appearance and surface protection complicate the plating of small parts in Westinghouse Electric & Manufacturing Company's Meter Division. Parts varying in size from minute pins and small movement gears to relatively large meter frames and case sections are plated in automatic and semi-automatic machines, barrels and still tanks according to carefully-prepared detail process specifications covering each type and grade of finish. Prepared jointly by the engineering and production departments, each specification shows the process determined to be the most economical for the particular finish required.

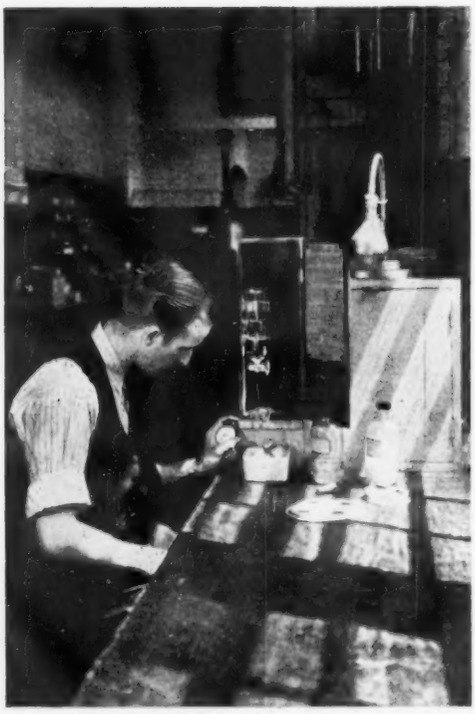
Copies of the specification book are kept in the cleaning and finishing sections, where they are available to each employee. All work requisitions and identification tags show a finish number which corresponds with a sheet in the specification book. Each sheet tells in detail the method to be used in preparing the part for plating, the plating process to be followed, and the solution to be used. Plating time, solution temperature and current density are recorded; each controlling factor is listed. This close control is paying dividends in quality and uniformity of plate, as well as in reduced unit costs.

Oil and grease adhering to surfaces of parts to be plated is removed in a recently installed conveyor-type degreaser. The parts are placed by hand in baskets hung from the conveyor bars, and are carried through the following sequence: (1) hot vapor chamber, (2) dip in boiling solution, (3) dip in rinse water, (4) hot vapor chamber, (5) drying chamber, and (6) delivery at other end of machine. Here a second operator removes the parts to tote pans for delivery to the shotblast machine or to the plating room. Prior to the installation of this degreaser, parts to be placed were passed through a washing machine on a slat-type conveyor, but trouble was experienced with oil and grease occa-

A large portion of the parts are given a matte finish in this multi-table shot blast unit. Two passes are required to finish a part on both sides



Special insulated racks hold parts that are sent through the 68 rack full-automatic zinc plating machine. The plating units in this set-up are inclosed in a separate room for fume control



Drop test shows thickness of zinc plate. Each elapsed second indicates 0.00001 in. thickness of plate. Zinc plate usually is applied 0.0003 in. thick

sionally being left in corners and pockets. This, of course, prevented adherence of the plate at these points and caused it to peel.

Approximately 70 per cent of the work now is given a matte finish by shotblasting before plating. The shotblast unit used for this purpose has eight 24-in. diameter rotary tables which operate continuously to carry the parts through the blast zone and return them to the loading and unloading position. Most of the parts are turned over on the tables by hand and sent through the machine a second time so that both sides will have the same finish. Other parts, particularly die castings, that are finished by spray paint instead of plating, also are sent through this machine, since the matte finish so obtained permits good adherence of the paint to all portions of the part's surface.

Automatic Zinc Plating

Zinc plate is applied to the largest percentage of the parts now going through the plating room, having replaced cadmium plate to a large extent. Improvements in zinc plating solutions and processes have permitted this change, made necessary because of recent marked increases in the cost of cadmium.

Parts requiring zinc plate are passed through an automatic plating machine on specially designed racks. These racks are insulated, except at the points where the parts are hung, and are loaded by girls working at benches near the end of the plating machine. Loaded racks are hung, two at a time, on hooks suspended from the machine's conveyor and carried through the following sequence: (1) dip in caustic electrocleaner solution, (2) dip in plain water and spray with water to remove any scum carried over from caustic tank, (3) dip in acid solution to remove all traces of oxidation, (4) dip in water and spray, (5) dip in cyanide solution to remove all traces of acid, (6) travel through zinc plating tank for approximately 14 min., (7) water dip and spray, (8) second water dip and spray, (9) dip in boiling caustic solution, (10) pass through drying chamber where hot air is directed against parts by nozzles along each side, (11) pass through cooling chamber where cold air is directed against parts by similar nozzles, and (12) remove racks to bench and replace with racks of unplated parts.

Full cycle of this machine normally requires about 30 min., the conveyor speed being variable for different parts. Base plates for certain meters are carried through at a speed of 5 ft.

per min., with a plating current of 1,900 amp. at 6 volts. Frames for these same meters require a speed of 5½ ft. per min., with 1,700 amp. at 5 volts. Racks are lifted from tank to tank in the cycle by constantly-rotating, carefully timed arms are carried through each tank by an overhead chain conveyor. The zinc plating solution used is maintained slightly acid for better corrosion resistance of the finished plate. A standard zinc solution is used and the following proportions are maintained per gallon of solution: zinc metal, 4.50 oz.; total cyanide, 9.35 oz.; caustic soda, 10.0 oz. Small additions of a brightening agent are made regularly.

Racks of parts removed from the automatic zinc plating machines are hung in front of a work bench where girls remove the pieces, inspect them, then place them in trays for transfer to the lacquer room. A standard drop-test thickness test is used for testing the thickness of plate applied by the automatic zinc plater. In this test, the sample is rubbed lightly with a special cleaning solution, then dried and placed in a dish so that the test solution will drop on the spot to be tested. From 80 to 120 drops of solution per minute are directed on the piece and a stop watch is used to measure the time required for the appearance of the base metal. Each elapsed second is equivalent to 0.00001 in. thickness of plate.

Copper, nickel, tin and black oxidized copper plates also are applied to large numbers of parts. There is a small amount of brass and ammonia-black plating, also some special plating operations, including precious-metal plating, on the smaller parts. Most of the parts brought into the plating room are stored in tote pans in a rack near the office. Samples are taken from each lot and placed in bread pans in a control rack nearby. Each pan carries an identification showing part number, finish number and daily production requirements. When the tote pan has been emptied, parts in the bread pan also are removed and plated.

Samples of parts with which trouble has been experienced in proper identification, particularly those of approximately the same shape or made in right- and left-hand styles, are shown on a sample board with identifying cards. This prevents mixing parts in the plating barrels when they are similar in appearance; it also aids in taking inventory or shipping parts for which tags have been mislaid.

Parts plated in the semi-automatic nickel and copper plating machine usually are of such a nature that they can be racked conveniently by girls working at a bench near the machine. Pieces are racked so that the total area placed on each rack is approximately the same for all racks to be plated at the same time.

Sequence of operations prior to nickel-plating brass parts in the semi-automatic machine is as follows: (1) rack work, (2) dip by hand in a caustic electrocleaner tank, (3) rinse in tank of clear water, (4) dip by hand in a "burn off" solution to remove any film on the surface, (5) dip in clear water, (6) hand dip in "bright dip" solution, (7) hand dip in three successive tanks of clear water on the way to the semi-automatic machine. The burn off solution consists of discarded bright dip solution with an added portion of sulphuric acid. Bright dip solution consists of two parts of sulphuric acid and one part nitric acid, with approximately 0.6 oz. of sodium chloride being added to each gallon of this solution. It gives a bright clean surface for plating. Burn off and bright dip solutions are kept in 20 gal. crocks set in a water tank, so that the solutions will be kept cool. The three water dips that follow the bright dip prevent transfer of acid to the nickel plating solution and remove the possibility of an oxide film forming on the surface of the part before it reaches the plating tank.

Cycle in the semi-automatic machine is varied from 10 to 75 min., depending on the size of the part and the thickness of the plate required. Drive for the conveyor of this machine includes a friction disc for varying the conveyor speed. A standard nickel solution consisting of the following proportions per gallon of solution is used: metallic nickel, 3.2-3.6 oz.; boric acid, 2.0 oz.; sodium chloride, 1.5 oz. This solution is checked at regular intervals and nickel-salt or other make-up added as required. The pH of the solution is held at 5.8 in this machine and in the nickel still-tanks, where same solution is used. Small additions of magnesium sulphate have been found to help keep the solution normal.

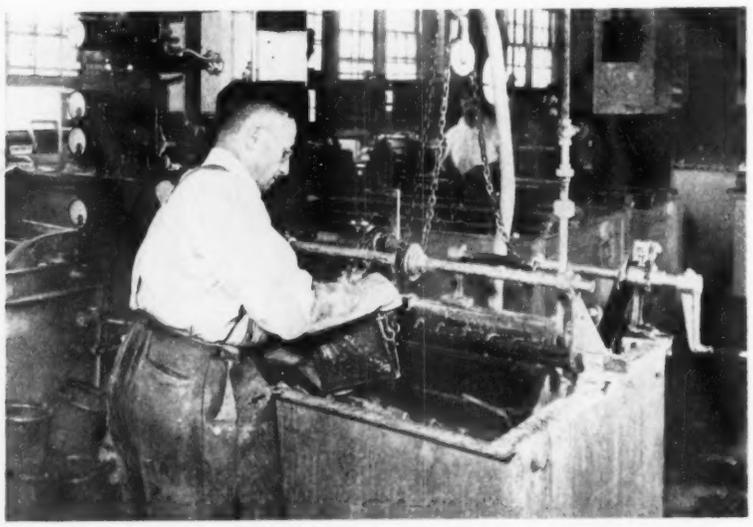
The wide variety of work going

Bread pans hold sample lots of parts being plated. Foreman and production control clerk determine status of any job quickly with this arrangement

through the semi-automatic machine makes it economically impossible to check the area of the parts for current density control purposes. Hence an automatic current control is used to hold current density at the proper value. This averages between 10 and 15 amp. per sq. ft. for the work being done.

Work coming from the semi-automatic plating machine is hand dipped in cold water, then in hot water at about 180-200 F., and then rolled by hand in a sawdust box and blown clean with an air hose. Work having very small or blind holes is not put in the sawdust, but is rapidly blown clean with an air hose. This is to prevent the holes from being filled with sawdust. From here the racks go back to the bench where girls remove the pieces and inspect them.

Bright dipping is omitted for any iron or steel work that goes to the semi-automatic machine for nickel plating and it is dipped in muriatic acid, otherwise the process is the same as for brass work. Phosphor bronze work also omits the bright dip and uses muriatic acid, then it is dipped in hot water and given a quick dip in a cyanide solution, then water rinsed before being placed in the semi-automatic machine.



Barrels are used for nickel, copper and tin plating small parts in quantities. Flat parts placed in these barrels usually are mixed with screws and other hardware to break up the load

A large portion of the work going through this department is plated in barrels, each having its own solution tank. These barrels are lined with vulcanized rubber and are driven by a separate variable-speed motor drive arrangement. For nickel plating, the solution is made somewhat stronger in nickel salts than for the semi-automatic machine, having the following proportions per gallon of solution: metallic nickel, 5.5 oz.; boric acid, 5.0 oz.; sodium chloride, 1.5 oz. Sulphuric acid or ammonia is added regularly to maintain pH at 6.0 for barrel nickel plating. Work is run for about 30 min., with each barrel being loaded to just below the center line. Flat work is broken up with bolts, nuts and other hardware, both to permit the plating of a wide variety of work in the same time and to give a better plating job. Parts that go in the barrels for nickel plating are placed in nickel-chrome baskets for the same bright dip cycle as for the semi-automatic machine racks. Approximately five of these baskets are required to load each barrel.

Parts to be tin plated have the same preparation cycle as do parts that are to be nickel plated. Current density in the tin plating barrels is about the same as for nickel plating, but 6 volt current is used instead of 12 volt. Plating barrels rotate at approximately 6 r.p.m. with a 20 min. cycle for tin plating. A similar barrel is used for cadmium plating small iron and steel parts in a 1-hr. cycle. This plate requires a 1-min. acid test and current density is held at 20 amp. per sq. ft. with 12 volts. Ball anodes in wire basket holders are used for cadmium plating.

Work having blind holes that must not be acid eaten, or left with acid in the holes to dry to an acid salt, is not cleaned in acid but is: (1) dipped in benzene for several hours to soak through any oil or grease left from the machining operation, (2) dipped in hot water to remove the benzene, (3) dipped in an alkaline cleaner, then soaked in the electric cleaner, (4) dipped in clean cold water, (5) basket plated in still tanks, (6) rinsed in cold water, (7) boiled in clean hot water for 10-15 min. to remove all traces of the nickel solution, and (8) dried in 180 F. oven for 10-15 min.

Current control on all tanks is adjustable for varying requirements and all still tanks have a means for agitating the bars holding the parts. Where the parts are placed in small baskets for plating, these are not agitated, but are shaken by hand occasionally to rearrange the parts in the basket. In this case, the basket never is raised from the solution as it would cause a second plate to start on top of the first. Basket work requires from 15 to 30 min. for nickel plating on brass and about 1 hr. for nickel plating on iron. For a number of parts, it has been found best to nickel plate over a copper plate.

Large parts to be copper plated are plated in still tanks while the smaller parts are plated in barrels. Parts to be copper plated have no water dip between the cyanide dip and the copper plate tank, otherwise the process is the same as for the preliminary cycle for nickel plating. Copper plated work to be oxidized after plating is cold water rinsed, and then dipped in a water and sulphur solution, then water dipped and dried in sawdust or air blast. Approximately 90 per cent of the jobs require lacquering after being oxidized.

In order to reduce the severity of acid and alkaline burns and damage to eyes, two first-aid cabinets have been set up in the department with full directions being given on an instruction card in each cabinet. Remedies for alkaline burns are kept in one cabinet while those for acid burns are kept in the other. These are for emergency treatment only. All cases of burns are sent immediately to the medical department, after first-aid treatment.

Good housekeeping and careful solution control have been found to be of primary importance in producing quality plating work. A definite two-week cycle has been set up for chemical analysis of the solutions in each plating tank and a three months drain and filter cycle is set up for all tanks. Zinc tanks in the automatic machine have additions to solutions made daily as the solution is critical, while the solutions in other tanks have additions made semi-weekly. The pH is checked daily in nickel tanks, other solutions are checked less frequently. Percentage of rejects has been reduced to less than 1 per cent by means of this process control.

DAD SAYS

Quitting a Job Was the Old Way of Finding Out What Kind of a Job You Had

EVERY few days—if you're listening—you'll hear some one wishing for the "good old days" back again. I've heard so much of this that finally I asked the men. "Ain't you making better wages than you ever did? Do you have to work as hard or as long as you did? Haven't you a better place to work in? Don't you have better lunch rooms, better coat rooms and better toilets? Haven't you a better hospital and don't you get insurance now?"

And when you ask them these questions, they all say things are better than they were but still we old timers all know the fellows are not happy around the plant like they used to be. Now I've been trying to figure this out and there's only one reason I can see for it.

Back when things were going good, a man could usually get another job if he was any good and especially if he had some experience. So if a foreman got on a man's nerves or if he didn't like the gang he was working with, why he just quit and got another job. Or if you couldn't get along with your foreman, he fired you.

The result was that the men who stayed working for a foreman liked him and he liked them and there wasn't a lot of grouching going on all the time.

But since the depression a man can't get another job if he does quit so he just stays on where he is. Lately the government won't let the foremen fire anybody so they have to keep their men whether they like them or not.

None of those I've talked to have figured it out this way—of course they wouldn't—but still I think this has more to do with their wishing for "the good old days" than anything else. But when I get it figured this far, I'm stuck, for I can't see—the way things are going—how we're going to bring back the "good old days" so the men can be independent like they was.

Chips Form and Fall In Slow Motion

Jones & Laughlin successfully uses high speed movies to study machinability and the built-up edge

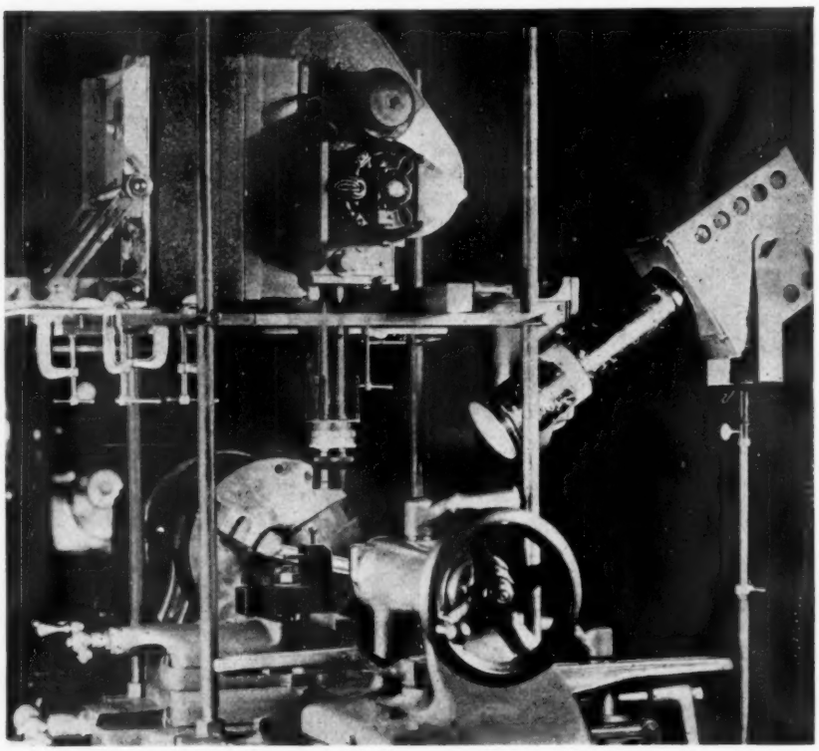
Y. J. BRUCE
Metallurgical Engineer
Jones & Laughlin Steel Corporation

METAL cutting has long been the subject of intensive research on the part of steel manufacturers, machine tool builders, tool steel makers and producers of cutting lubricants. But these studies by numerous investigators over the past 50 years have still left many problems.

Occassionally, when machining two steels of the same composition, it has been found that chips are produced which are different in behavior. This has led to the thought that there must be a difference in the characteristics of the built-up edge at the tip of the tool. It is well known that this built-up edge or wedge of metal grows, breaks down and renews itself with great rapidity.

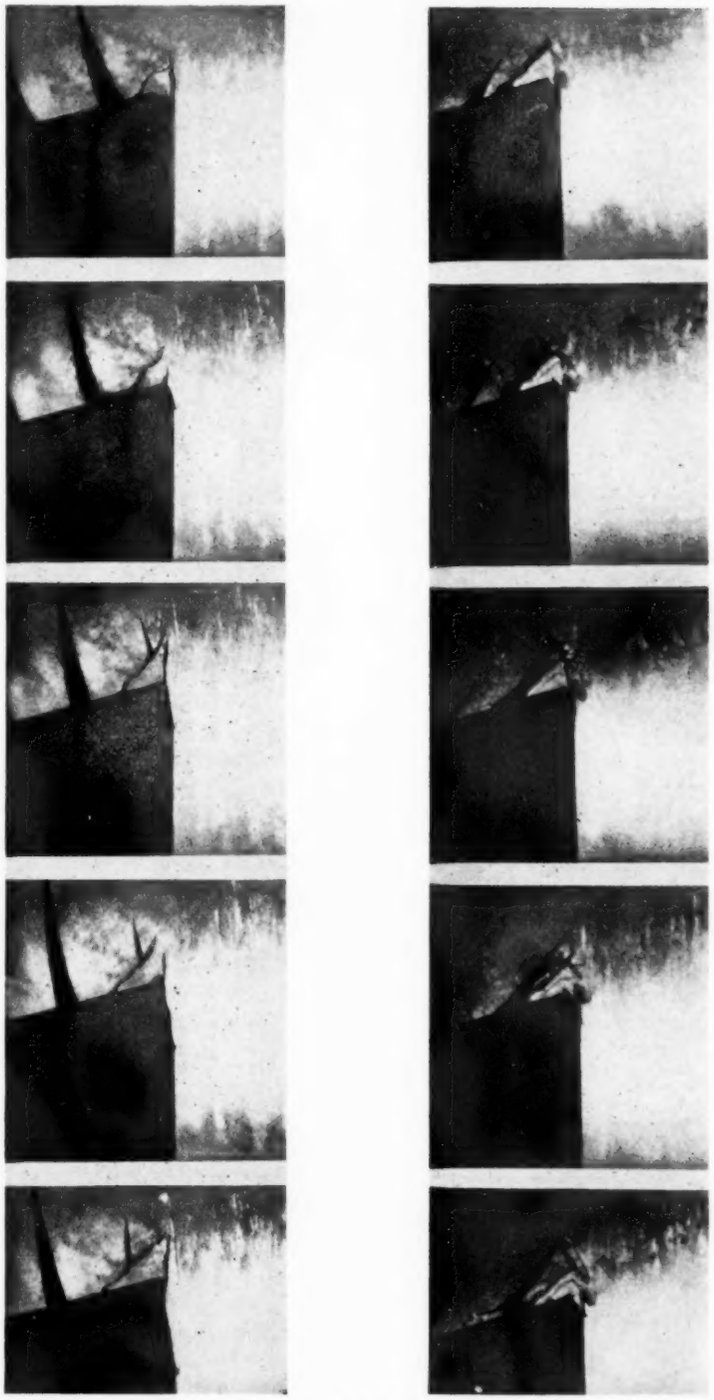
To better understand this action, the Research and Development Division of Jones & Laughlin has used a high-speed motion picture camera to catch the split second action of an automatic lathe and to make visible the action of the built-up edge. In this connection others have done similar work by microscopic study of samples taken at intervals during cutting and also with the high-speed camera.

In our work, the camera was mounted on a rigid frame built on the tool carriage in such a way that the lens followed the tool action. All the pictures were taken from a point directly above a set-up similar to a top forming operation on an automatic lathe. Special lighting equipment was used to illuminate brilliantly the small area at the tip of the tool, an essential in securing good results. Originally the investigation was designed to study the built-up edge formed by different steels, but it has included some work of an exploratory nature with feeds, speeds and tool clearances. The size, shape and quality of the cutting tool has been held constant.

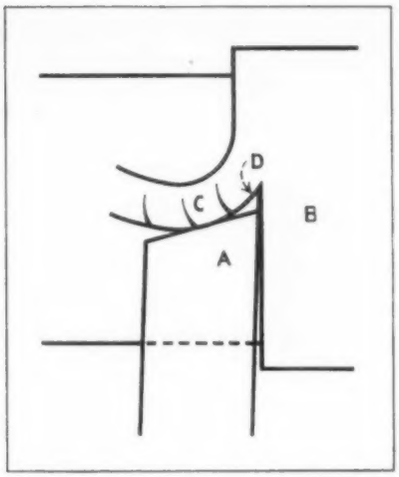


A high speed motion picture camera mounted directly above the work takes pictures at 800 frames a second

Two sets of five successive frames representing two different actions are shown. These pictures were taken at a speed of 800 frames per second and are normally projected at 16 frames per second. In other words, a standard 100 foot reel, consisting of about 4,000 frames, requires only five seconds to expose, but is ordinarily projected in about four minutes. The five frames represent the action in the short period of about 1/160 second, and in normal projection would flash across the screen in $\frac{1}{3}$ second. At the spindle speed used in this particular case, the pictures show what took place when a $\frac{3}{4}$-in. cold-drawn round bar of bessemer screw steel revolved 0.085 surface inches.



Five frames at the left show the chip build up while in those at the right a new chip forces the first away from the tool face



A large view of the area photographed shows the tool *A*, the bar *B*, chip segments *C* and the built-up edge *D*

For certain types of study, the normal projection of the film at 16 frames per second is highly satisfactory, particularly to show repeat cycles and sequences of chip and built-up edge behavior. In other cases, the speed of projection is reduced or the film stopped at predetermined sections so that certain frames are projected individually. Each has its advantage, and both have been used in our studies. In connection with a normal rate of projection, it has been stated that five frames require only $\frac{1}{2}$ sec. to pass the eye, which is too fast to catch the detail. Careful individual examination of such pictures as are produced here show changes that are often missed when the reel is run off as a movie.

It will be observed that only the extreme tip of the tool is shown. The line sketch is a diagramatic explanation of this area. The chip itself forms the gray and black area in the upper left corner of each frame. The top frame of the first set shows the tool tip in direct contact with the bar, and frames 2 to 5 inclusive show the deposit of chip material clinging to the leading edge of the tool. A wedge-shaped cutting edge over which the subsequent segments flow is quite visible. This wedge is not a permanent formation, and under certain conditions does not exist at all.

In the second set, the first frame shows an already formed built-up edge at the tip of the tool and illustrates its protective position over the tool edge, also how it acts as a cutting medium. Frames 2 to 5 inclusive show the start of a new chip coming down over the built-up edge and forcing the already formed chip segment away from the tool face.

Like an Ice Breaker

The action shown by the high-speed camera film may be aptly compared to a river containing considerable debris in flood time flowing past an island or possibly better still, to the movement of an ice breaker through a frozen stream. In either case, a built-up edge is formed, acting temporarily as a cutting edge, material flows past it, the edge breaks down, another forms and is pushed ahead to repeat the process continuously.

It has been found that such films have a particular value for investigating machinability. Many details can be recorded on this permanent record and studied later as other problems of machinability arise. These pictures have led to a better understanding of what occurs during the machining of steel by showing phenomena not visible to the eye.

Fast Braze in a Thin Shell

Purolator production was stepped up through the use of a low melting-point silver alloy which gave a firm joint while eliminating distortion

R. L. IRWINE
General Factory Superintendent
Motor Improvements, Inc.

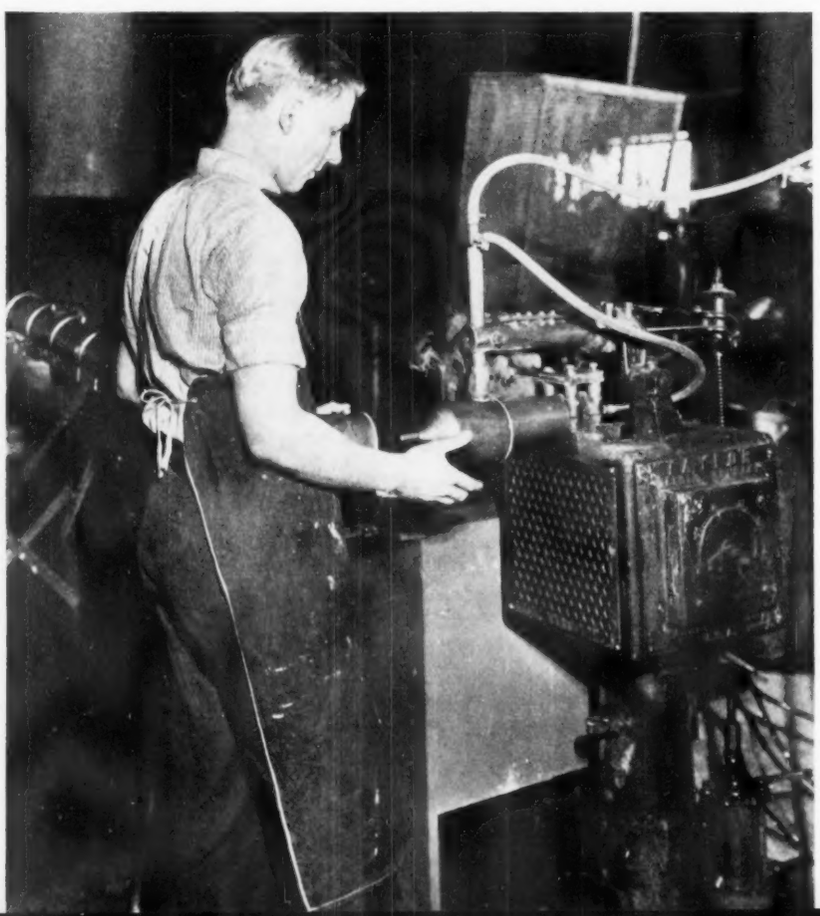
RECENTLY our production department was faced with the problem of building a Purolator of a much lighter material than had been used previously. A lighter product manufactured at a lower cost was desired, with the stipulation that the quality of the finished job be in keeping with the reputation built up for this oil filter.

Redesigning the filter for a lighter gage metal was a matter presenting only one problem. This was the question of giving to the light-weight case proper strength at what would normally be its weakest point, that is, at the cone-shaped bottom. It was also necessary to braze a spud to the shell at a point a small distance down from its beaded top. For the heavier gage metal with a 3/32-in. wall, formerly used, it was practicable to use a gas torch for brazing even at the higher temperatures required for a bronze brazing alloy, because localized over-heating neither materially affected the metal structure nor distorted the shape of the shell. Further, any bad effects could be corrected by annealing.

On the new shell, however, using a metal which came from the final deep draw at a thickness of only 0.042 in., it was obviously impossible to use a gas torch because the metal would be affected and the cylindrical beaded top of the shell would be certain to be distorted to an elliptical form of varying maximum and minimum diameters. Nor could annealing be resorted to. Even if a brazing alloy of lower flow point than that of the copper alloy were used, too much would depend upon the individual manual skill to avoid spoilage and delays in brazing with a torch.

It was necessary, therefore, to find some means of brazing which would eliminate the use of a torch, to smooth out the operation and to put it on a mass production basis. In our preliminary studies we became interested in the possibilities of low melting-point silver alloys and made a thorough investigation of them. The feature most interesting to us at that time was the low flow-point of the alloy and the kind of joint it made possible. Our thought was that if we could devise some means of providing the heat required for the brazing operation on the spud and at the same time eliminate dependence of the human factor, we would be certain to get a better joint than we were getting with a copper alloy. We were decidedly interested in the possibility that we could restrict our entire heat operation to a 1-in. circle.

From a study of various methods of supplying heat for brazing, we discarded the idea that we might get satisfactory results from a furnace operation and decided to make some experiments with an old spot-welder in our plant which might be converted into an incandescent carbon brazing unit. We found first it would be necessary to provide a transformer which would give us the temperature in the carbons we required for the braze, that is, about 1400 F. This was a fairly easy job and when the transformer was hooked up, our experiments began.



A foot treadle forces the electrode down pneumatically and turns on the brazing current

Shells are prepared for brazing by lining them up in a trough, inserting the silver alloy rings and the brass spuds to be sealed in place

At first, we used two carbon electrodes of the same thickness. When the spud was clamped in place over a ring of silver alloy, called Sil-Fos, which had been placed in the recess in the shell coated with flux, and then the entire assembly placed between the electrodes and the current turned on, we got the brazing temperature we desired, but there were a number of difficulties.

One was the tendency of the two electrodes to heat up to the same temperature, with the result that the bottom electrode caused too great a temperature for the shell of the unit with which it came in contact, and some distortion of the shell took place. At the same time the top electrode, in spite of the aid of the heating up of the spud by the passage of the current, did not heat up the upper part of the joint quite rapidly enough, with the result that we could not always get uniform results.

Our next step, therefore, was to vary the thickness of the electrodes, making the top one thicker and the bottom one thinner, in order to balance the heat input so as to provide for completely uniform heating of the metal and brazing alloy, top and bottom. We were able to standardize on the relative thickness of the two electrodes and get uniform results with no further difficulty. Up to this point, however, we had been clamping the spuds in place and maintaining the required pressure between the electrodes by a foot-lever action. We then proceeded to work out a means of eliminating the clamps on each shell and of providing a uniform pressure to hold the spud firmly against the brazing alloy ring and the shell. We also wanted to put the use of the current and the time of brazing operation on as much of an automatic basis as possible.

Our experiments first gave us the means of maintaining pressure on the assembly, without clamps and of making the contact of the electrodes with the work. Using compressed air at about 50-lb. pressure, a simple foot lever control was devised which, when pressed, forced the two electrodes together and at the same time actuated a relay which closed the current circuit. In the meantime, a shell was daubed at the hole for the spud with flux, a Sil-Fos ring set in place and a spud placed over the ring. This was then set in position between the electrodes. When contact was made and the assembly held in place by the air pressure, the current quickly provided the temperature for the brazed joint. Unless the operator removed his foot from the lever at the right time, however, too much heat was generated and the joint was still somewhat distorted. We were obliged to devise a means of cutting off the current at the right time without dependence on the judgment of the operator. This was finally accomplished by the use of a time relay which cut in by the actuation of a foot lever and then cut out automatically after a definite time interval determined by our experiments.

Thereafter, except for a few refinements, we had this bottle-neck beaten. We found it necessary to provide a centering spindle in the bottom electrode in the form of a tapered piece of lava which would pass up through the shell and the spud to center the spud automatically on the shell independent of its position as the assembly was set in place between the electrodes. We found it advisable to use an alloy for the top electrode in order to cut down on the necessity for frequent replacements. A tungsten alloy is satisfactory for this work.

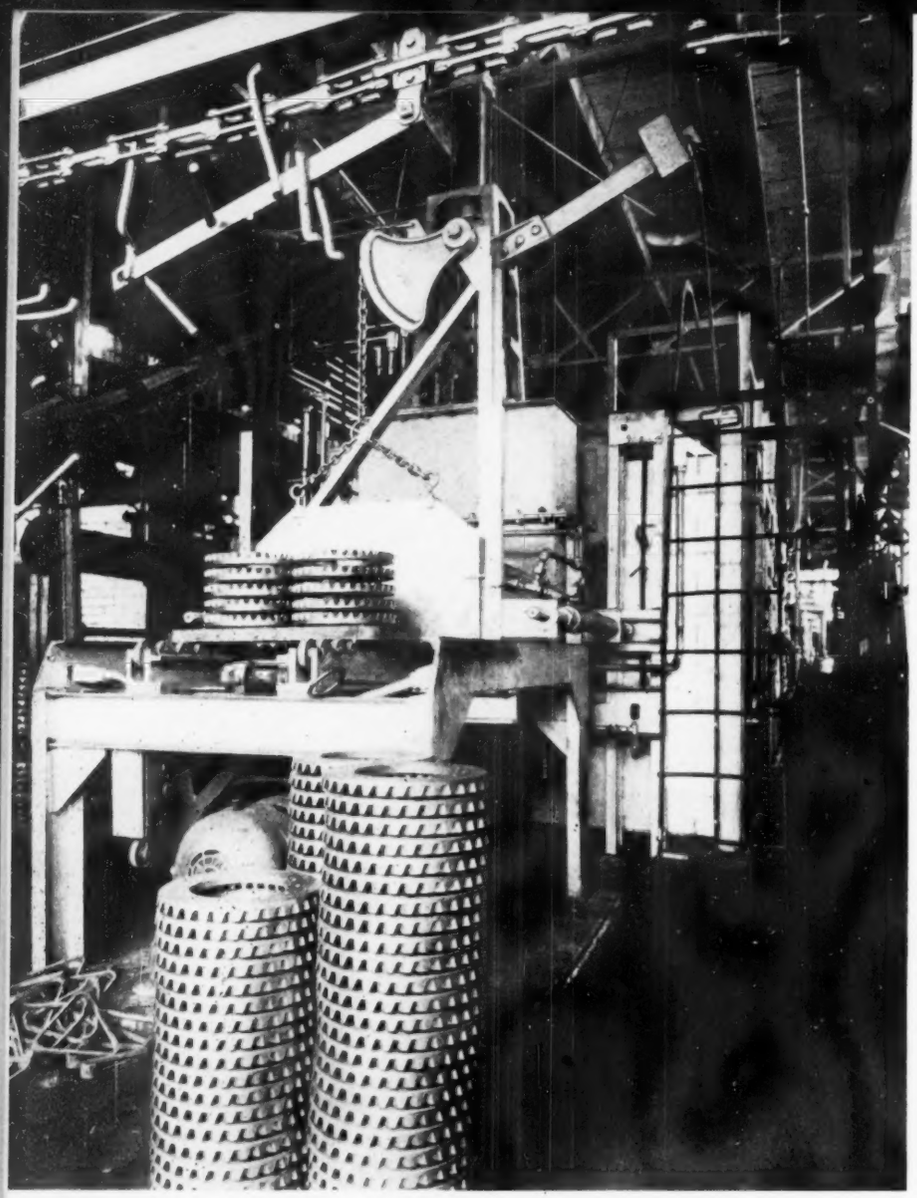
As the operation is carried on in our plant now, it fulfills almost all the requirements of a good mass production job. The operator lines up about twenty shells in a trough, with the holes for the spuds lined up and facing upward. He goes down the line of shells with a brush, applies the flux to each hole, then places the Sil-Fos ring in the recess around the hole. Next the spud is put in place and the trough with its shells is moved up to the converted spot welded, ready for brazing.

Picking up the first shell, the operator puts it over a cone-shaped mandril surrounding the bottom electrode and lava pilot which centers it exactly under the top electrode. He then presses the foot lever which forces the two electrodes into contact with the case assembly. The current has gone on the instant his foot depresses the lever and the assembly starts heating up at once. Less than three seconds later, the joint has reached brazing temperature the Sil-Fos has melted and penetrated all the space between the spud and the shell (and penetrated into the metal of the spud and shell as well), and the current has been automatically cut off by the relay. The operator lifts the completed shell off and puts the next unit in place, having reached for it before the current is shut off.

Altogether, from the time an assembly is picked up from the trough to the time the next one is picked up, less than five seconds have been taken up.

Our tests always pull the metal of the shell apart before there is any sign of failure at the joint itself. The test consists of putting a two-foot bar into the spud and weaving see-saw up and down until the metal around the joint fails. Uniform application of heat in a uniform time interval gives us the dependable production this operation calls for, and the dependable performance of the silver brazing alloy has been such that we have never had any trouble on this operation.

We are not quite through with this operation. We want to make it a bit more automatic, by improving on our present foot-pedal operation and by making it possible to feed a row of assembled units into the machine at one end and to be handled completely automatically there on.



An impressive number of continuous gas carburizing furnaces were in successful operation by 1935. This furnace is used for carburizing heavy-duty ring gears which are pushed through on alloy trays

Cavalcade of Carburizing

We have learned much about carburizing and allied case-hardening processes; but tremendous possibilities for improvement lie in the future

WALTER F. HEDRICH
Surface Combustion Corporation

SHORTLY after the Civil War, the then head of the Patent Department of the United States submitted his resignation, stating that he saw little or no reason to continue to take the people's money for his services inasmuch as most of the important things already had been invented and little was yet to come.

Seventy years or more have passed since this resignation was submitted, but it has only been within the past fifteen or twenty years that the cavalcade of carburizing has seen major steps forward. Until some time after the end of the World War all carburizing was done in small batch furnaces, using both boxes and compounds, as well as in small rotary-muffle type furnaces employing natural gas as the carburizing medium. It was not until about 1920 that the need for continuous processes brought the construction of the first continuous pack carburizing furnace, which was oil-fired and employed cast-iron rails, as well as heavy cast-iron boxes and trays. Growth of these materials through oxidation presented a major maintenance problem. However the continuous method, even at that time, demonstrated many of the advantages with which we are familiar today.

This initial installation was followed shortly by others employing better heat-resisting alloys for the mechanical parts of the furnace and improved heating media, such as gas and electric power, to provide more accurate temperature control and distribution. At this time the work, after being carburized, was either cooled within the box and direct quenched. Both cases then would require a reheating for final hardening. The second reheat on direct quenched work was resorted to because steels available at that time did not give proper metallurgical structures with the single quench.

Electricity, in competition with oil and gas as a means for heating furnaces, was under the serious handicap of higher cost. To alleviate this condition, the counterflow furnace was developed to take advantage of the heat lost because of the withdrawal of hot boxes of work from the furnace. This arrangement materially increased the number of pounds of work which could be produced with a given unit of electric power, thus

lowering the cost considerably.

The first gas-fired pack carburizing furnace employing this counterflow principle was installed about 1924. In this furnace the same net recovery of heat could be attained and the arrangement had the further advantage of causing the flue gases to pass back through the interchange zone, permitting further preheating of the incoming work by means of gases which otherwise would be wasted.

The next step in improvement in general furnace design was to increase the length of the heat interchange zone in greater proportion to the high-heat zone within the furnace. In some cases, the interchange zone at each end was carried as much as 60 per cent of the length of the high-heat zone. This change was made to take the fullest possible advantage of the recovery of the heat through the counterflow principle. Naturally, this resulted in a rapid increase in the size of the unit and further increase the investment because of the amount of alloy involved. Likewise, the time of work in process was greatly increased.

At the start of the depression production was reduced to such a low point that it was impossible to operate the large furnaces with any satisfactory degree of efficiency. Also, it was discovered that the carburizing reaction itself is reversible and that when the work was allowed to cool too slowly through certain critical temperatures, there was a carbon migration from the steel surface back into the atmosphere within the carburizing box. This would result in soft work after hardening, unless heavy scaling was permitted in the reheating furnaces.

These factors brought about a rapid tendency toward: (1) smaller furnaces in multiple units; (2) the elimination or drastic reduction of heat interchange zones and a return to the straight-flow carburizing principle; and (3) a change from electric heating to gas-firing, which would give practically all of the advantages of electric firing with an elimination of the high demand charges.

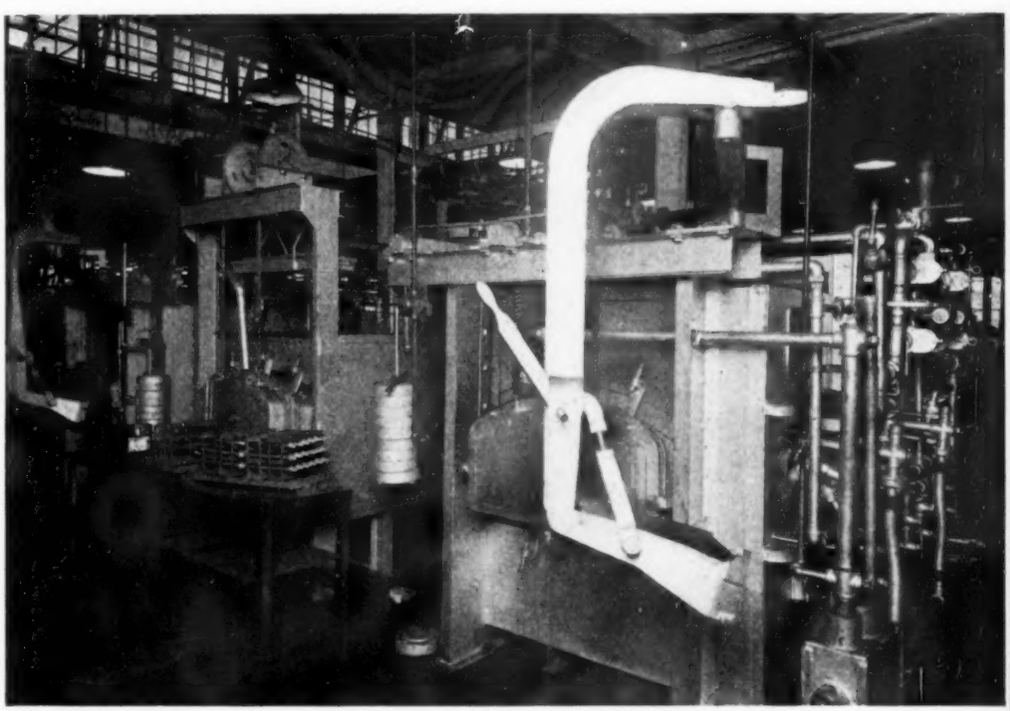
It is of particular interest to note that up to about this time furnace manufacturers operated largely as building contractors, constructing mechanical furnaces to incorporate processes as specified by the user or developed by others. In other words, the furnace manufacturer was responsible only for the piece of equipment; not being primarily concerned with processes. Research departments maintained by various furnace manufacturers soon began to take an active part in developing and improving processes and then in the construction of equipment to interpret these processes correctly.

About 1930 these research efforts began to bear fruit. Continuous nitriding was developed to the point where it could be used on production operations. The advantage of this case-hardening method was a reduction of the time cycle to approximately 15 hr., where former batch methods required a cycle of from 60-90 hr. Furthermore, the continuous method of nitriding was made practically independent of the rate of dissociation of ammonia, while the batch method required that the dissociation be maintained at a low point within close limits. The disadvantage of nitriding as a case-hardening medium at that time was found to lie principally in the high price of the special steels required to properly apply this process.

With the technique and information developed in the nitriding research, it was only a step to the completion of the development of a continuous gas carburizing process. The first unit of this type employed the so-called "Eutectrol" process and was installed in the latter part of 1931. This furnace has been followed by approximately 70 others, which now are in operation in various plants in four countries; all of them producing a better product at lower cost than did former methods.

By 1935 an impressive number of continuous gas carburizing furnaces were in successful operation. Most of them produced from 0.030-0.090 in. depth of case. Four types of equipment were employed. (1) the direct-quench type, which permits the work to be quenched readily from the carburizing or slightly lowered heat resulting in a finished product; (2) the cooling type, which was employed on work which had to be cooled from the carburizing heat to permit subsequent machining operations which were to be followed by a hardening operation; (3) a combination of these two methods produced a "reheat" type of equipment in which the work is carburized, cooled within a muffle to a point below the critical temperature, then reheated to slightly above the critical temperature for direct quenching; and (4) the batch furnace, employing all of the essential features of the process as is used in continuous furnaces, except that the work is loaded and withdrawn as a complete charge.

Each of the first three of these types of furnaces can be made either with hand control or for fully-mechanical operation; any number of contributing factors govern the choice between these two methods of operation. It is sufficient to say that quality can be maintained with both methods



These two batch-type carburizing furnaces are separated by a cooling chamber. Here the work is loaded and withdrawn as a complete charge and it is possible to make changes in temperature, cycle and other factors on each successive heat.

of operation. In batch-type furnaces it is possible to make changes in temperature, cycle, steel and other factors on each successive heat if necessary. Therefore, this type of equipment usually is preferable to the longer continuous-type furnace in jobbing shops where wide variation in product is the rule.

In 1935 much interest was directed to the possibility of eliminating cyanide as a reheating medium for alloy gear steels. Considerable interest also developed in heat-treating higher carbon alloy steels without scale and without decarburization. It was found that the gas carburizing furnace could be adapted readily to meet both of these requirements, thus leading to the development of the so-called "light case carburizing" equipment installed during the latter part of that year.

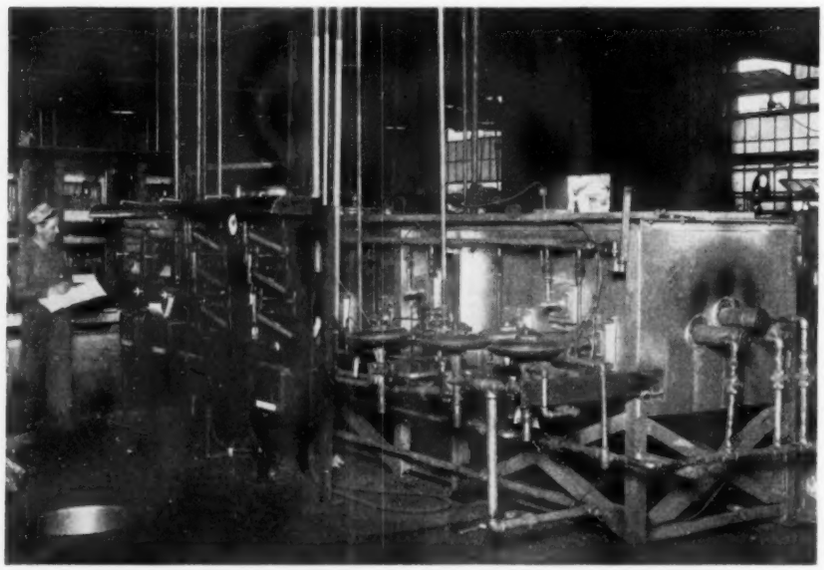
It is sometimes thought that since carburizing is carburizing, there is no difference between heavy case and light case. This is not necessarily the case. It should be obvious that a controlled atmosphere must be in balance with the steel with which it is used and that the balance must be controlled carefully. All controlled atmospheres normally considered in this connection are on the reducing side, rather than on the oxidizing side of the scale, provided the equipment is satisfactorily sealed against outside air intrusion. A controlled atmosphere employed to prevent decarburization during the hardening of 0.50 carbon steel would add no carbon to the surface of the steel if it were in proper balance. It would be slightly carburizing, however, to a S.A.E. 1020 steel, although it would be so weak that the time cycle to secure a satisfactory case would be entirely too long when considering heavy case work. This same gas, however, could add an appreciable amount of very thin case to a lower carbon steel, and because of the absence of higher hydrocarbons, the work could be withdrawn from the quenching medium quite clean.

In order to put a 0.060-0.70 in. case with a carbon content of up to 1.2 on a piece of steel, it would be necessary to use a considerably more potent carburizing gas. This requires the relatively heavy use of heavy hydrocarbons, with a definite tendency toward an appreciable amount of soot or carbon on the work as it is discharged. This is true because the atmosphere must be in balance with the surface carbon condition desired. Light-case carburizing, therefore, varies from heavy case carburizing in time, temperature, carburizing gas and, at times, even in the method of handling. Fortunately, both processes may be employed in the same equipment with entirely satisfactory results.

Under certain conditions neither light-case carburizing nor straight clean-hardened high carbon steel is tinuous nitriding with the continuous in which it is to be employed. It is only logical then to combine continuous nitriding with the continuous gas carburizing process to add a nitride-carbide case similar to that which is secured in cyanided work. This improved process is carried out with a gas atmosphere which is a combination of carburizing gases and ammonia. A variety of such combinations may be used to produce a case with any desirable concentration of carbide and nitride and ranging from about 0.002 in. to any desirable depth of case. This process may be called by one of several different names such as "white casing," "carburized nitriding," or "dry cyaniding." The latter term is descriptive of the type of case which will be secured and the word "dry" is employed to differentiate from the liquid working condition of a molten cyanide bath. The process should be confused in no way with cyanide material, for it is similar only in that the results may be the same providing the controlled atmosphere is set at the proper point.

The combination of a carburizing and nitriding case probably will find its greatest application in the future on that type of work which is to be direct quenched, with the temperatures of the reactions being dictated largely by the metallurgy of the steel employed. However, this process is by no means restricted to quenching, since a superficial file hardness may be secured on practically all types of steel, without quenching, by allowing the work to cool within the atmosphere to a suitably low point before it is withdrawn into the outside air. Since distortion of the work many times is a function of temperature and quenching strains it is possible to eliminate, or greatly reduce, this undesirable characteristic by permitting the work to cool in the carburizing atmosphere. It is to be appreciated, of course, that this process can be used only on types of work where no improvement of the steel core is necessary.

It can be stated safely that a recitation of the progress in carburizing and allied case hardening processes at the present time is, in reality, a recitation of increasing knowledge concerning the actions and interactions of gases with respect to steel at elevated temperatures. Much already has been learned regarding these inter-related reactions, but it is to be remembered that the commercial application of these physical phenomena has taken place only within the past ten years. Much has been learned during that time, but we probably have learned only enough to make us realize that a tremendous field for improvement lies in the future. Undoubtedly within that unknown physical, chemical and metallurgical future there are many processes and mechanisms that will be used for case hardening steel of which we have not dreamed at present.



This carburizing gas preparation unit serves two furnaces. Various analyses of carburizing gas are used to produce varying results on different steels

Fig. 1—Thirteen separate pieces are welded together to form the complete cable sheave at the left. The large disk is a stamping, the four spokes (lower left) are flame-cut, while the hub is rolled and welded from flat stock

Fig. 2—Three stages in the fabrication of a 14-in. welded steel gear. The hub, rim and oil ring are rolled from bar stock, the disk being cut from ½-in. plate. Blanks are produced at the rate of thirteen per man per day

Tractor Parts Joined By Electric Arc

Here's how welding is done in a plant where welding has become a state of mind

R. A. GAST
The Lincoln Electric Company

ANYONE interested in the possibilities of welding, as applied to machinery manufacture, will find this science developed to a high degree at the Peoria, Illinois, plant of R. G. LeTourneau, world's largest manufacturer of tractor-drawn earth moving equipment. Here, nearly everything is arc welded: production tools, jigs and fixtures, overhead cranes, jib cranes, heat-treating furnaces, conveyors, buildings, houses and every possible part of the product manufactured. The welding is of excellent quality and the appearance of the welded work is equal to that of any other type of construction.

LeTourneau employs arc welding almost to the exclusion of other comparable manufacturing methods, its designers having formed the habit of thinking in terms of this process. As a result, many machinery parts, which would ordinarily be considered unsuited to welded fabrication, by firms less familiar with welding, are produced as a matter of course by this method of joining metals.

In this article are described a few typical examples of the machine parts fabricated by arc welding. Small, seemingly complicated assemblies have been selected because of the high quality workmanship required and attained in their production. The parts chosen are a sheave, a gear and a wheel.

Welded Cable Sheave

The cable sheave is an excellent example of how a relatively small machine part, having a considerable number of components, is fabricated by welding. The sheave is composed of thirteen individual pieces of steel. These parts, which can be seen in Fig. 1, consist of the four curved cable flanges, the four flame-cut spokes, two flat disks, one stamped disk (the large one), an oil ring and a piece of flat stock rolled and welded for the hub.

In fabrication these thirteen parts are jig-welded. The disk and spokes are placed in the jig and tack-welded. The assembly is then turned over, and the four curved flanges are tack-welded in place. The next step is to locate the hub in the assembly. This is done in another jig, following which the hub is tack-welded in place. The final welding is done in a third jig which permits rotating or tilting the work to any desired position. A completed sheave, with the thirteen pieces welded into one integral ma-

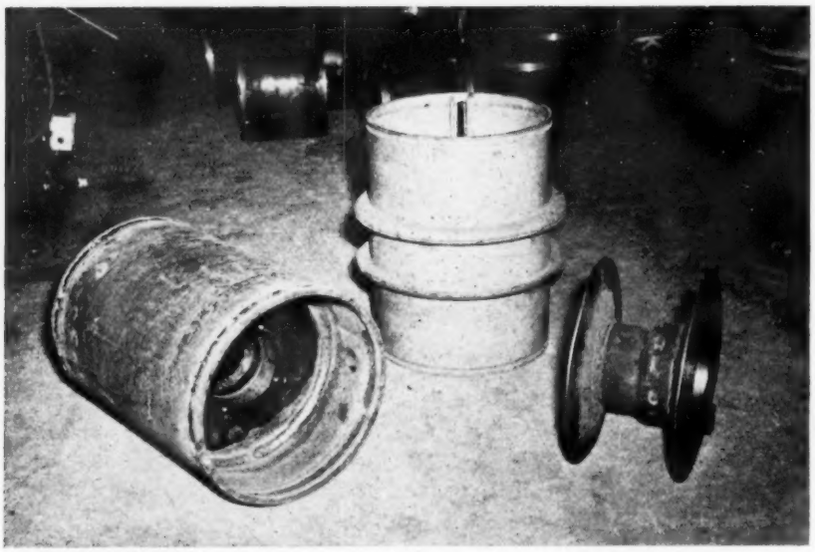


Fig. 3—This large dual wheel is built up from nine major parts. The hub-disk unit at the right has its ball-race seat bored before being welded into the rim to form the wheel at the left

chine part, can be seen in the illustration. Electrodes ¼-in. in diameter are used in the groove to get a smooth concave surface for the cable.

LeTourneau also fabricates all gears which go into its products. When they are finished, it is impossible, without close inspection, to distinguish the arc welded gears from cast units. The welds are smooth and uniform.

Two sizes of gears are regular items of production. These are of 12-in. and 15-in. inside diameter (inside to inside the gear rim). In fabricating the small gears, LeTourneau takes a piece of bar stock 1-in. thick by 2¼-in. wide and rolls it into a hoop of 12-in. inside diameter, arc welding the ends together. A piece of ⅜-in. plate is then cut for the disk. For the hub, a piece of 4 x 1¼-in. bar stock is rolled to a 7-in. diameter (outside) and arc welded. The final part, an oil ring, is rolled from a piece of ⅜- x 1¼-in. bar stock to 9½-in. outside diameter.

The actual fabrication of a gear consists of placing the hub, disk and rim into a jig and arc welding them together. The work is then permitted to cool, following which the oil ring is arc welded to the disk. The complete blank, along with its component parts and a finished gear, is shown in Fig. 2.

Many advantages are claimed for the fabricated gears. There is definite economy since welded fabrication permits use of less expensive steel. Only the teeth and a portion of the rim are case hardened. The use of rolled steel enables the gear to withstand shocks since the relatively soft disk and hub have greater absorptive power than a more brittle material. Production of gears, up to the machining, is at the rate of thirteen per man per day, including setting the parts up and welding.

Wheels are a large item in LeTourneau production. They are made in a variety of sizes for the various models of earth moving, scraping and rooting equipment. A particularly interesting unit is the large dual wheel which has the appearance of a barrel. It is 13½ by 20 in.

The hub consists of two pieces of flat stock rolled and welded. The two halves are first set together and tack-welded. Finish welding of the hub is done in a jig following which it is machined inside and out and the ball-race seat bored. The two disks are then placed on hub tack-welded, then finish-welded in a jig. This assembly can be seen at the right in Fig. 3. After the disks have been welded to the hub, they are machined to true size and holes tapped for the hub caps.

The next step is the application of the rim, which is 20-in. wide including a 1-in. ring at each end. The rim, rolled from a piece of ¼-in. plate, is placed over the hub-disk structure, then welded to the disks on the inside. Fabrication of the wheel is completed by cutting valve stem slots, arc welding the valve stem guards in place and setting and welding the fixed rims for the tire stops.

Out of the Shadows

JOHN W. RIX
Production Engineer, Waco Aircraft Company

HAVING recently spent three months, working in one of the largest aircraft factories in England, and visiting several others, I would like to add a few things to the article on Britain's shadow plants, and some of the disadvantages of that system of emergency aircraft production.

One of the fundamental American aircraft policies is that an airplane designed and built a year ago is out of date; even such big planes as the flying fortresses, are no sooner being delivered in volume, than a bigger and better one, the P15, is developed. In the small and medium sizes of commercial airplanes, manufacturers have found that they cannot sell design that has not got all of the latest developments in it.

The English shadow plan, is to pick certain engines and airplanes which have been "time proven", and tool these up elaborately for emergency production, if needed at some future time. To American standards, these airplanes would be mostly obsolete by the time they were "time proven". I had pointed out to me with pride, hundreds of beautiful progressive dies in die sets, made for parts of the Auro "Audax" airplane, a machine designed eight years ago; and had explained to me that, if ever they were in a war, they could snap right into production. Incidentally these planes were being made at that time, with the usual thorough English workmanship; all fittings of stainless steel, with polished edges, to last and last and last.

The idea of a factory completely equipped to produce one particular model, and then left to stand until needed, is completely foreign to the American idea of keeping up to date.

Another point against shadow factories is that every big war is entirely different from the preceding one. The last war lasted four years; the next one may be so terrible it will be all over in four weeks, and what good will shadow factories be then? The trend sems to be for sudden and fast action, and the country with the most up-to-date planes, already built, is going to have a big advantage over others.

AMERICAN MACHINIST *Reference Book Sheet*

Time-Data Sheet No. 11

Handling Operations—Heat-Treating and Cleaning—I

PART:

Parts requiring heat-treatment and/or sandblasting.

OPERATION:

Degrease, normalize, carburize, nitride, harden in salt bath or furnace, and sandblast.

WORK STATION:

Heat-treating department.

LOCATION:

Wright Aeronautical Corporation, Paterson, N. J.

ALLOWED TIME—MINUTES:

Allowances shown are for handling elements only, no allowance is made for the time work is soaking in the degreaser or for furnace time. Where parts are placed in degreasing basket a few at a time the allowed time for degreasing does not include an allowance for removing the parts from the basket; this is included in the allowed time for sandblasting, which follows degreasing. Relaxation allowance is included in all time values shown.

DECREASE:

Where parts are placed in the basket a few at a time:
Allowed minutes per piece $= (0.14 \div L) + (1.82 \div N)$
Where parts are small and are dumped from pan into basket:
Allowed minutes per piece $= 3.47 \div N$
Where: L = Size of lot handled into basket at one time.
N = Number of pieces placed in basket per load.

Degreasing Elements:

Symbol	*Description of Element*	*Std. Min.*
A	Get basket	0.10
B	Place pieces in basket by hand, per lot handled at one time	0.14
C	Pick up pan of small parts and empty into basket	0.65
D	Pick up basket and hang in degreaser	0.30
	—Soak—	
E	Agitate basket in solvent	0.50
F	Drain and hang basket in cool solvent	0.15
G	Hang basket in vapor	0.50
H	Drain and remove basket	0.27
J	Clean and line tote pan	0.80
K	Dump parts from basket into tote pan	0.20

Synthesis:
Where parts are placed in basket a few at a time:
Place lot of parts in basket $= B = 0.14$ min.
Allowed time per basket $= A + D + E + F + G + H = 0.10 + 0.30 + 0.50 + 0.15 + 0.50 + 0.27 = 1.82$ min.
Where parts are small and are dumped from pan into basket:
Allowed time per basket $= A + C + D + E + F + G + H + J + K = 0.10 + 0.65 + 0.30 + 0.50 + 0.15 + 0.50 + 0.27 + 0.80 + 0.20 = 3.47$ min.
Example: Where a large part is loaded 15 in a basket and is handled two at a time, the standard allowance per piece is:
Allowed minutes per piece $= (0.14 \div 2) + (1.82 \div 15) = 0.192$, use 0.20 min.
Note: Baskets are 8-in. in diameter and 12-in. deep. A basket holding 25 lb. of work is considered as the maximum load.

SANDBLAST—TUMBLING BARREL:

Allowed minutes per piece = Total time for necessary elements, each translated into element time per piece in lot or barrel load. The number of pieces per barrel load depends on size of piece. Average tote pan load may be considered a barrel load. Barrel measures 18x18 in.

Description of Element	*Std. Min.*
Move tote pan to barrel, per lot	0.15
Place pieces in barrel:	
Light forgings (up to 3 lb.), per piece	0.05
Heavy forgings (3 to 6 lb.), per piece	0.09
Light tube assemblies, etc., per piece	0.03
Push rods, long light studs and bolts, per piece	0.008
Dump light tote pan of nuts, studs, etc., per barrel load	0.20
Dump medium tote pan of nuts, studs, etc., per barrel load	0.35
Dump heavy tote pan of nuts, studs, etc., per barrel load	0.54
Put tote pan aside, per lot	0.11
Close door and open air valve, per barrel load	0.11
—Sandblast time—	
Return to machine and close air valve, per barrel load	0.16
Open door, per barrel load	0.08
Remove pieces to pan or skid:	
Light forgings (up to 3 lb.), per piece	0.06
Heavy forgings (3 to 6 lb.), per piece	0.08
Light tube assemblies, etc., per piece	0.03
Push rods, etc., per piece	0.011
Small parts, nuts, studs, etc., with 1-qt. wire scoop, per scoop load	0.32
Pour oil over pan load, where parts require oiling, per lot	0.54
Deliver to outgoing inspection, plating room, etc. (two lots per trip), per lot	1.75

SANDBLAST—CABINET MACHINE:

Allowed minutes per piece = Total for necessary elements, each translated into element time per piece in order or cabinet

NOTE: The term "allowed time" used in these and following data represents the time required by any worker to perform the given unit of work, using average skill, showing average effort, under average conditions, with average consistency, allowing for fatigue, personal needs and unavoidable delays. *It is the time within which the worker is expected to perform that work.* All times shown are in decimal minutes. Accurate conversions to decimal hours and seconds can be made by means of the following formulas: Decimal minutes $\times$ 0.1667 = decimal hours; decimal minutes $\times$ 60 = decimal seconds. The data given represents standards developed for use at the Wright Aeronautical Corporation's plant at Paterson, N. J., for conditions of work existing in that plant. Each allowance should be checked in the light of local conditions before being applied in any other plant.

AMERICAN MACHINIST *Reference Book Sheet*

Time-Data Sheet No. 12

Handling Operations—Heat-Treating and Cleaning—II

load. Allowance for sandblasting element is to be determined by observation or comparison.

Description of Element	*Std. Min.*
Take order, in box or tote pan to cabinet, per order	0.15
Pick up piece and place in cabinet:	
Push rods, per piece	0.01
Oil tubes, small gears and other parts handled 4 to 8 at a time, per piece	0.02
Medium-size parts, gears, propeller nuts, etc., handled individually, per piece	0.04
Large parts, cams, accessory drive shafts, etc., handled individually, per piece	0.09
Close cabinet door, per cabinet load	0.15
Move up chair, put on gloves, start sand, per cabinet load	0.35
Sandblast, per cabinet load	Time Study
Remove gloves and open door, per cabinet load	0.34
The following elements are for parts to be oiled and delivered to Machine Shop or Inspection:	
Get baskets or hooks, per cabinet load	0.11
Remove pieces from cabinet, shake to remove sand and place in basket:	
Push rods, per piece	0.01
Oil tubes, small gears, etc., per piece	0.04
Ring gears, etc., to 6-in. diameter, per piece	0.08
Dip basket in oil and set aside to drain, per cabinet load	0.18
Place large parts on hooks and oil:	
Shafts—place one piece on hook and oil, per piece	0.13
Cam rings—place three pieces on hook and oil, per piece	0.07
Get pan or box, per order	0.12
Place pieces in pan or box:	
Tubes, small gears and other parts by handfuls, per piece	0.01
Medium size pieces, per piece	0.04
Large gears, shafts and cams, per piece	0.08
Deliver to Inspection, center lapping machine or outgoing station, per order	2.50
The following elements are for parts not oiled to be delivered to hardening furnace or plating room:	
Get pan or box, per order	0.12
Remove pieces from cabinet, shake to remove sand and place in pan:	
Tubes, small gears and other parts by handfuls, per piece	0.04
Gears and similar parts handled individually, per piece	0.08
Large parts, cam rings, etc., handled individually, per piece	0.11
Deliver to Inspection, plating room, hardening furnace, center lapping machine or outgoing station, per order	2.50

SANDBLAST—ROOM:

Allowed minutes per piece = Total for necessary elements, each translated into element time per piece in lot. Allowance for sandblasting element is to be determined by observation or comparison. The number of pieces in room at one time depends on the size of the piece. The operator must have space in which to work.

Description of Element	*Std. Min.*
Carry piece to room and place on table:	
Cylinder forgings, per piece	0.36
Machined cylinders, master rods, etc., per piece	0.26
Cams and other medium-weight pieces, per piece	0.16
Intake pipes and other light-weight pieces, per piece	0.09
Close door, put on coat, apron and helmet, and start sand, per lot	2.05
Sandblast, per lot	Time Study
Stop sand, remove coat, apron and helmet, and open door, per lot	1.60
The following elements are for parts not oiled	
Remove pieces from room to skid:	
Cylinder forgings, per piece	0.36
Machined cylinders, master rods, etc., per piece	0.24
Cams and other medium-weight pieces, per piece	0.13
Intake pipes and other light-weight pieces, per piece	0.08
The following elements are for finished parts to be oiled and delivered to Inspection or outgoing station:	
Remove finished pieces from room to oil tank:	
Large pieces, 2 per carry, per piece	0.27
Medium pieces, 3-4 per carry, per piece	0.15
Light pieces, 4-8 per carry, per piece	0.08
Dip part in oil and place aside to drain:	
Large pieces, per piece	0.32
Medium pieces, per piece	0.16
Light pieces, per piece	0.08
Remove from oil drain to skid:	
Large pieces, per piece	0.22
Medium pieces, per piece	0.11
Light pieces, per piece	0.05
Deliver to Inspection, outgoing station or plating room, per lot	3.50

NORMALIZE:

Typical handling elements incidental to the operation of a car-type normalizing furnace in which stands are placed on floor of furnace with a fork-type electric lift truck. These elements are those found necessary for work at a standard 30x54x24 in. furnace.

Allowed minutes per piece = $(23.58 \div L) + (V \div L) + P$.

Where: L = Number of pieces per furnace load.
P = Total of variable elements per piece.
V = Total of variable elements per furnace load.

Description of Element	*Std. Min.*
Elements required per furnace load:	
Set 8 stands on cooling platform, per load	1.76
Take truck to platform, raise 8 stands, per load	0.78
Take truck to skid of work, per load	0.76
Take truck to furnace and raise load, per load	1.26
Shut off burners to allow acid to act, per load	0.72
Raise door and thermocouple, per load	0.46
Run load into furnace and lower, per load	0.68
Run truck out and aside, per load	0.45
Pour ½ pint Muriatic acid on load to form loose protective scale, per load	0.82
Lower door and thermocouple, per load	0.38
Return truck to position, per load	0.44
Record load time and temperature on data sheet, per load	1.46
Set pyrometer, per load	0.81
Open burners on furnace, per load	1.79
Check heat on recorder (twice at 0.81 min.), per load	1.62
—Furnace Time—	
Take truck to furnace and raise, per load	0.96
Raise door and thermocouple, per load	0.46
Run truck under load, raise load, per load	0.67
Run truck out and aside, per load	0.45
Lower door and thermocouple, per load	0.38
Run load to platform and lower, per load	1.13
Return truck to position per load	0.35
—Cooling Time—	
Hand truck with skid or pans up	1.81
Truck pieces to sandblast, per load	1.42
Place 8 stands away, per load	1.76
Total, per load	23.58

(*To be Continued in an early issue*)

NEWS OF THE INDUSTRY

War Department Allocates $15,000,000 to Private Concerns for Ordnance

Remaining $10,000,000 of year's total expected to be awarded within the next few weeks

BLAINE STUBBLEFIELD

McGraw-Hill Washington Bureau

WASHINGTON—As Europe's fighting machines miss crashing again and again by the breadth of a diplomatic adjective, and as America's militarists plan to ask Congress in 1939 for huge Army and Navy expansion money possibly totaling a billion dollars, the War Department announces allocation of $15,000,000 to private manufacturers for anti-aircraft guns and other ordnance. This is the first step since the World War toward bringing industry into the ordnance picture of national defense.

The big order was announced by Assistant Secretary of War Louis Johnson in a statement dated September 9 and in a supplemental release September 25. It lists more than 100 items but not that many companies are involved; some of them got several jobs each. The Department's total appropriation for ordnance is $25,000,000 for this year; allocation of the remaining $10,000,000 is expected in a few weeks.

Concentration by the War Department on anti-aircraft munitions is significant to news readers during the past few weeks who have noticed international war talk revolving around military air power of the various countries. Of course the Department's allocations to private industry do not nearly account for the whole program as other millions are spent on government arsenals, etc.

Since the World War nearly all ordnance of War has been produced in federal plants, despite the lesson so tragically taught in 1918 when government facilities proved inadequate and failed to deliver enough quantity soon enough to be effective. Since then, private industry has tried constantly to convince Congress that for the government to maintain productive capacity in many forms of munitions sufficient for emergency would be impractical and uneconomical. But conflicting interests intervened and it was not until the last Congress that the policy was changed. Then came the revolutionary educational orders law, and this ordnance appropriation for industrial production. But even now organized labor is urging Congress to place *all* munitions manufacture—and that covers a lot of territory—under the government. This objective is supported by a strong bloc in Congress which believes that practically all government munitions production is graft. Only by constant vigilance can the proponents of industrial production hope to maintain their policy.

The educational orders program, and this industrial ordnance appropriation, both dovetail into the Munitions Control Board's industrial mobilization organization. Under this system of dummy contracts and carefully-drawn blue-prints and elaborate plans, the War Department could set the plants of 10,000 manufacturers to work on war goods overnight. No doubt the aim of Government is to expand its use of industry for munitions production.

U. S. Government Contracts Awarded to Metal-Working Firms

(Awarded from Sept. 9-22 inclusive)

Contractor	Govt. Agency	Commodity	Amount
Dalrymple Equipment Co., Amory, Miss.	War, Engineers	Tractors	$28,000
Ex-Cell-O Corp., Detroit, Mich.	War, Ordinance	Rifling machine	197,070
"Automatic" Sprinkler Corp. of Americs, NYC	WPA, Treas., Proc.	Sprinkler systems	52,000
Carrier Corporation, Syracuse, N. Y.	Navy, S&A	Refrigerating plants	21,581
Cincinnati Milling Machine & Cincinnati Grinders, Inc., Cincinnati, Ohio.	Navy, S&A	Profiling machine	28,421
The E. L. Essley Machinery Co., Chicago, Ill.	War, Ordnance	Honing & lapping machine	55,170
Camden Forge Co., Camden, N. J.	Navy, S&A	Racks & pinions	218,200
Ajax Electrothermic Corp., Trenton, N. J.	War, Ordnance	Motor generator set	83,700
United Aircraft Corp., Hamilton Standard Propellers Div., E. Hartford, Conn.	Navy, S&A	Propellers	45,000
Eclipse Aviation — Div. of Bendix Aviation Corp., E. Orange, N. J.	Navy, S&A	Starters, cartridge	33,800
Walter Kidde & Co., Inc., NYC	War, Air Corps	Oxygen cylinder assembly	125,984
Sperry Gyroscope Co., Inc., Brooklyn, N. Y.	War, Air Corps	Indicator assemblies	376,600
Eclipse Aviation — Div. of Bendix Aviation Corp., E. Orange, N. J.	War, Ordnance	Transmission systems	211,710
Rochester Engineering Corp., Rochester, N. Y.	War, Ordnance	Extruding machines	31,200
Pratt & Whitney Div., Niles-Bement-Pond Co., Hartford, Conn.	War, Ordnance		204,383
Jones & Lamson Machine Co., Springfield, Vt.	War, Ordnance	Gun turning lathes	54,876
Ex-Cell-O Corp., Detroit, Mich.	War, Ordnance	Rifling machines	197,070
American Tool Works, Cincinnati, Ohio.	War, Ordnance	Gun boring and turning lathe	55,000
Warner & Swasey, Cleveland, Ohio.	War, Ordnance	Turret lathes	32,271
R. K. Le Blond Machine Tool Co., Cincinnati, Ohio.	War, Ordnance	Gun turning and boring lathes	32,408
Ferracute Machine Co., Brighton, N. J.	War, Ordnance		60,310
Lindberg Engineering Co., Chicago, Ill.	War, Ordnance	Annealing furnaces	19,998
Lloyd & Arms, Inc., Philadelphia, Pa.	War, Ordnance		83,440
Davenport Machine Tool Co., Rochester, N. Y.	War, Ordnance	Automatic screw machines	27,398
Waterbury Farrel Foundry & Machine Co., Waterbury, Conn.	War, Ordnance		153,777
Canister Co., Phillipsburg, N. J.	War, Ordnance		79,772
E. W. Bliss Co., Brooklyn, N. Y.	War, Ordnance	Presses	136,255

Flanders Voices Confidence At Management Congress

WASHINGTON—Over 2000 delegates from 22 countries heard new policies formulated by prominent industrialists speaking at the seventh International Management Congress convening here during the week ending Sept. 23. Meeting for the first time on American soil, the congress comprised an effort "to evaluate the place of management in a changing social and economic scene."

A plea for a revival of initiative and enterprise in American business and industry was made by Ralph E. Flanders, president of the Jones & Lamson Machine Co., Springfield, Vt. Speaking on "The Balancing of Incentive and Security," Mr. Flanders expressed belief that the country's resources, technical progress and numbers of population justified preparations for expansions both in standards of living and in industrial activities.

As a means toward effective realization of existing possibilities, Mr. Flanders advocated a clearer understanding of the need for a balance between security and incentive. "What we have to learn," he said, "is that there is no long-time security without incentive and initiative. For a continuance of achievement in our western civilization, we must strike a balance between the two policies."

Granting and in some measure advocating society's obligation to youth, the unemployed, the underprivileged and the aged, Mr. Flanders was, nevertheless, critical of the viewpoints of the social worker "whose mind is fixed on security alone," and of the politician "who finds the easy road to maintenance of power that of the promise of security."

Outstanding activity of the business session of the congress was the election of William L. Batt, president of S.K.F. Industries, as president of the organization. The first American so honored, he succeeds Viscount Leverhulme of England. Long a prominent figure in the metal-working industry, Mr. Batt has also served on Secretary Roper's Business Advisory Council.

Other final business of the congress included the selection of Stockhold, Sweden, as the scene of the organization's next meeting in 1941

Exports of Machinery During August, 1938

	August 1938	July 1938	August 1937
Electrical machinery	$8,084,328	$8,006,504	$8,981,110
Power generating machinery except automotive and electric	1,384,950	1,039,548	1,412,065
Construction and conveying machinery	1,933,230	1,745,007	2,312,936
Mining, well and pumping machinery	5,240,719	6,177,260	5,708,431
Power driven, metal-working machinery	8,625,729	6,488,415	4,190,386
Other metal-working machinery	332,580	338,223	384,366
Textile machinery	449,557	624,594	1,034,596

Exports of Metal-Working Machinery During August, 1938

	August 1938	August 1937	July 1938
Engine lathes	$862,288	$260,619	$555,536
Turret lathes	296,500	222,946	273,530
Other lathes	181,034	99,875	252,586
Vertical boring mills and chucking machines	500,452	147,721	251,506
Thread cutting and automatic screw machines	187,892	232,598	327,499
Knee and column type milling machines	332,223	223,766	275,813
Other milling machines	1,214,704	278,203	578,739
Gear-cutting machines	236,361	142,769	272,286
Vertical drilling machines	105,030	41,599	34,730
Radial drilling machines	17,450	37,874	37,286
Other drilling machines	142,144	61,119	155,559
Planers and shapers	256,416	45,112	283,704
Surface grinding machines	338,304	84,979	155,735
External cylindrical grinding machines	429,427	103,325	164,466
Internal grinding machines	386,792	170,487	212,776
Tool grinding, cutter grinding, and universal grinding machines	306,150	154,398	174,805
Other metal-grinding machines and parts	210,275	174,398	235,356
Sheet and plate metal-working machines and parts	689,867	310,954	831,092
Forging machinery and parts	95,404	162,455	53,917
Rolling mill machinery and parts	874,220	442,430	626,454
Foundry and molding equipment and parts	228,787	179,566	117,950
Other power-driven metal-working machinery and parts	734,009	613,193	607,090

Other Metal-Working Machinery

Pneumatic portable tools	$84,042	$127,624	$96,389
Portable and hand and foot operated metal-working machines and parts	109,902	142,787	113,248
Chucks for machine tools	29,368	18,277	58,384
Milling cutters, machinery operated threading dies and taps and similar machinery operated metal cutting tools	36,749	49,852	38,384
Other metal-working machine tools	72,519	45,826	31,798

Tangeman to Address Machine Tool Dealers

PHILADELPHIA—W. W. Tangeman, vice-president and general manager, Cincinnati Milling Machine Co., will address the Associated Machine Tool Dealers of America during the organization's annual convention in Cincinnati beginning Oct. 10. Also featured on the program are a talk by W. E. Blank of National Cash Register Co. and a message of welcome delivered by Mayor Stewart.

Knisely Elected Head of Industrial Advertisers

CLEVELAND—The National Industrial Advertisers Association, in its sixteenth annual meeting, elected Stanley A. Knisely as its president for the coming year. Mr. Knisely, who is advertising director of Republic Steel Corp., will take the place of Frank Wyse, of Bucyrus Erie, who has presided over the affairs of the organization for the past year.

H. W. Dunbar Reviews Industry's Obligations

OYSTER HARBORS, MASS.—Progress made by the abrasive industry since the turn of the century was cited by Howard W. Dunbar, vice-president of the Norton Company and president of the National Machine Tool Builders Association, in an address before the Grinding Wheel Manufacturers Association here. In an interesting discussion entitled "A Long Look Ahead in the Abrasive Industry," Mr. Dunbar made the following prediction:

"If business is to survive it must sell itself to the millions of people in these United States. It must be patriotic, patient, honest, and have the courage to voice its basic importance, contesting if you will for the confidence of the people. It is high time that each individual business began to sell itself in addition to the products it manufactures. We should make known to all walks in our social life the high standards of principles and ethics which are a part of our business, without which we would be hopelessly lost, with nothing to sell."

Specifically, Mr. Dunbar asserted, "Our factories must become places where men like to work, and workers will find in our shops a place of pleasure rather than pressure, since intelligent action and leadership must replace regimented discipline."

DETROIT LETTER

Radical changes were dropped when sales outlook became confused . . . New engines for 1940 will require millions for new equipment . . . Welding is more widely used . . . Buick steps up to 1,000 cars per day . . . Fisher Body develops a "sunshine roof"

DETROIT—Mechanical changes requiring the purchase of quantities of new equipment have been avoided in 1939 cars for several reasons. Optimistic predictions of better sales have been made by leaders in the automotive industry, but executives have proceeded with great caution nevertheless. The outlook is disturbed by such factors as: (1) Will the public spend freely for new cars? (2) the domestic political situation, (3) unsettled foreign conditions that might cut off exports, (4) further losses arising from wildcat strikes or resumption of strong drives by labor.

Many radical changes were planned a few months ago. Automobile companies went so far as to discuss the new production problems with equipment suppliers, and indicated that machinery would have to be ready on short notice. Some machine tool concerns went ahead with the preliminary work, but orders did not materialize. It is generally understood, however, that provision has been made in the new models to drop in some of these new features if sales permit in the next few months.

There is no justification for believing that car manufacturers have "laid down" on the job. Major improvements appear in the bodies, and there are countless improved details both seen and unseen. Thus, while they have conserved capital, car builders are giving the public a product that is fresh in appearance, roomier, safer and a genuine improvement in transportation.

General opinion is in agreement that the competitive situation will force the adoption of radical changes in 1940. Informed sources declare that Cadillac will have the largest retooling program in its history. It will be remembered that the 16-cylinder engine was entirely revamped, thereby saving much space and weight. A fundamental redesign is said to be in process for one of its smaller engines. General Motors, as a whole, will also have a large program. Dodge and Plymouth are said to be thinking of new engines.

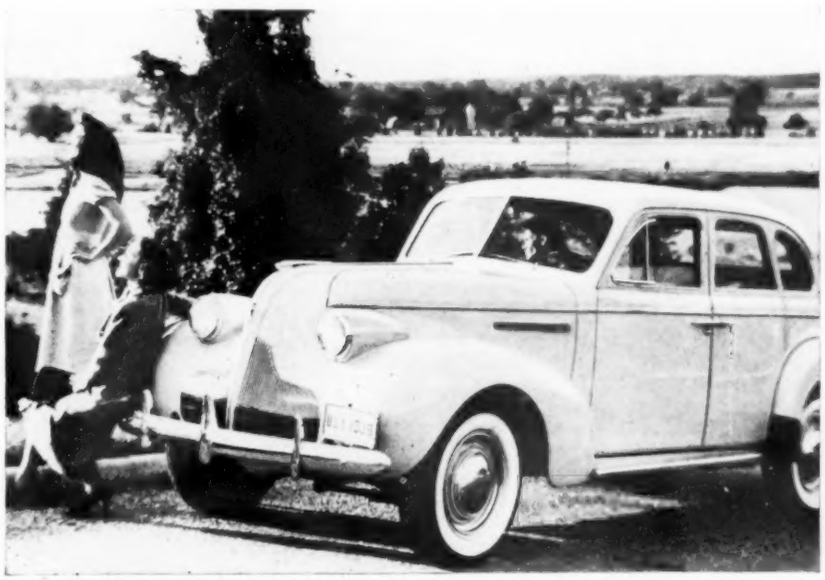
These changes should involve the expenditure of millions for the latest high-production machinery and wider adoption of processes that will remove metal faster and to closer limits of accuracy. By the first of the year machine tool and equipment salesmen will be able to get a line on next year's prospects, which should be much better than 1938 has proved in this area. Several leading firms report that total business for the year will be off about 75 per cent as compared with 1937.

Machine tool purchases have suffered through the lack of radical changes, but welding equipment has been widely adopted for assembling the components of the running gear and rear axles. Large orders were placed several weeks ago, and most of this equipment has been installed. Prospects for additional sales this fall are not considered bright, but welding equipment manufacturers are confident that they can sell quantities of standard and special equipment for 1940 models, especially if more radical changes are made.

Some of the noteworthy installations of electric welding machines are found in the Buick and Oldsmobile plants. Buick is butt welding torque tubes and assembling radius-rod brackets to the axle housing by "tear drop" (heavy projection) welding. Projection welding is also being used to attach the strut-rod bracket to the torque-tube housing, a job involving $\frac{3}{8}$-in. stock. The shear strength developed is 45,000 lb. as compared with a design requirement of 5,000 lb.

Applications of arc welding on 1939 cars have been extended by at least 20 per cent. Rear axles and running gear are also being assembled by this process. The new lower frame designs and the new tractor designs have increased the amount of arc welding on these assemblies by 40 per cent. The arc process for welding bodies, as first applied last year by Hudson, will most likely be adopted next year by at least two divisions of the large corporations.

Die-castings are being used more extensively. Suppliers are working close to full time, and their chromium-plating facilities are being pushed to full capacity. Pontiac has switched to die-cast grilles this year. The four pieces, two outers and two inners, weigh 11 lb. Chevrolet will retain the stamped grille, and the



Reversing a Style Trend—Just when it seemed the increasing fatness of car bodies would eventually shrink the windows up to mere portholes, Buick reverts to thinner pillars and sharper corners. Visibility is further improved by the narrow radiator shell

Chrysler lines also use stampings. Oldsmobile and Buick continue the die-cast construction, which they have favored for several years.

Further evidence of the automotive industry's desire to stimulate business through lower prices, is revealed by Buick's announcement of reductions of $51–102 on the most popular models. Substantial reductions have also been made on major accessories.

Buick expects to build more than 55,000 cars by the end of November, or approximately one-quarter of its goal for the model year. It has been in production since the middle of August, and is now operating on a two-shift basis to produce 900–1,000 cars per day. Employment exceeds 12,000, more than 8,000 having been rehired.

Four chassis models have just been announced by Buick. They are lower through improvements in chassis designs. Frames on the Series 40 and 60 terminate back of the rear spring seats. Independent front-wheel suspension is continued, as well as torque-free coil rear springing. Two optional rear-axle ratios, providing maximum performance or economy, are available for the Series 40 and 60. All models have a remote-control gear shift under the steering wheel, and a direction-signal control is fitted into the shift lever. Grilles are set lower in the catwalk section of the front end, permitting a narrower hood for better vision and bringing air to the radiator at greater pressure.

Oldsmobile will announce new models about the end of October. Like Pontiac, it will have three lines of cars, including a new "60" model for the low-price field. The automatic transmission will be continued as an optional feature at extra price. Oldsmobile will be the only General Motors car with this feature.

DeSoto began production of new models recently. It will have an optional overdrive mechanism giving the effect of five speeds forward. Last year the overdrive cut in at 35 miles per hour at the operator's will, but the mechanism has been changed to cut in at 25 miles per hour. Now it will operate with either the second speed or high speed. The advantage is that the operator can use overdrive where suitable and thus cut down engine speed. But if he should want a more effective gear ratio, when passing for example, he merely kicks the accelerator to the floor, thereby contacting a button that throws out the overdrive. A solenoid (electromagnetic) control effects release of the device.

Studebaker's overdrive is understood to work on the same principle. This car also has a mechanical-type remote gearshift. Exteriors have been functionalized in design and interiors have been styled by interior decorators. A new ventilating, air filtering and heating system has been designed into the car. The unit is located beneath the floor pan in the space formerly occupied by the battery. Air is drawn through a passage built into the body, is filtered and then passed through a hot-water radiator. Heated air is discharged beneath the front seat and distributed to both the front and rear compartments. An interior temperature of 70 can be maintained in zero weather.

All General Motors cars, except Chevrolet, are to be supplied with "sunshine roofs" as an optional feature costing up to $175. This is one of the outstanding developments of Fisher Body, and is adapted from European practice.

Extension of the use of coil springs has changed the specifications of the steel used for suspensions, and has caused a slight loss in tonnage for the steel makers. The loss is not so great as might be supposed because of the additional parts required by coil-spring suspensions as compared with leaf springs. The loss in dollar volume is slight because of the higher-cost steels now being used.

Application of lower-priced steels is being extended to other automotive parts wherever safety and efficiency are not impaired. There is a trend toward substitution of chrome steels for nickel steels, where correct physical properties in the lower-cost material can be obtained by proper heat-treatment. Body and fender sheet specifications remain unchanged as regards thickness. Steel tops demand sheets that crowd the 90-in. width limit. The number of sheets required for tops is not large, however, as compared with the industry's total sheet requirements.

Warner & Swasey Company staged an all-day program in Cleveland September 28 to celebrate completion of its 50,000th turret lathe. Customers and civic and industrial leaders of Cleveland were guests of the company. Here a group is examining this world-famous dividing engine which is accurate to one second of an arc. Charles J. Stilwell, Warner & Swasey vice-president, left, is demonstrating the machine to (left to right) Charles Deeds, vice-president and general manager, Pratt & Whitney Aircraft Co.; Clifford S. Stilwell, Warner & Swasey vice-president; J. C. Ward, Jr., assistant general manager, Pratt & Whitney Aircraft; Dr. James S. Thomas, president, Chrysler Engineering Institute and speaker at the dinner; and L. D. McDonald, Warner & Swasey.

A.S.T.E. to Repeat Tool Exhibition

DETROIT—Ford R. Lamb, executive secretary of the American Society of Tool Engineers, has announced that the annual membership meeting of the society and the second machine and tool progress exhibition will be held concurrently in Detroit during the week of March 13—18. The entire exhibition hall will be used and a full schedule of plant tours and technical meetings is planned.

SEEN AT THE WARNER & SWASEY CELEBRATION

Warner Seely, Warner & Swasey secretary, was one of the genial hosts.

Harold T. Johnson, Cadillac Motor; W. Peaslee, Cincinnati Milling Machine Co.; and W. R. Burger, Warner & Swasey.

Fred Reilly, Liquid Carbonic Corp.; W. Seloske, Sprague-Sells Corp.; C. T. Clyne, Bell & Howell; John E. Kunze, Warner & Swasey; and J. K. McFarland, Buda Motor Corp.

P. C. Nace, American Machine & Foundry; R. F. Nelson, Arma Engineering; Noble Clark, Warner & Swasey; G. P. Schiveley, DeLaval Steam Turbine; Peter Calabro, Pollack Mfg. Co.

H. Keller, Scintilla Magneto; L. D. McDonald, Warner & Swasey; H. Weart, Goulds Pump; H. M. Lucas, G. A. Yost, Lucas Machine Tool; W. C. De Graf, R. J. Blyth, Warner & Swasey

E. Ulliman, National Supply; W. M. Hartman, National Cash Register; A. F. Schnaitman, Warner & Swasey; W. H. Hartley, Hobart Mfg. Co.; and A. Ullrich, Gould & Eberhard

George Kummerer, Otis Elevator; L. D. McDonald and W. J. Henderson, Warner & Swasey

J. L. Smith, Continental Can and T. E. Rodgers, American Can

Charles H. Riley, Eclipse Aviation; Charles G. Crazioso, Frankfort Arsenal; and Stephen Lawson, Warner & Swasey

WATCHING WASHINGTON

Educational orders program taking shape . . . R.F.C. loans continue to increase . . . Andrews' principal problem still definition of interstate commerce . . . Objections raised by aeronautical organization against Walsh-Healey 60-cent minimum aircraft wage

McGRAW-HILL WASHINGTON BUREAU
(*Paul Wooton, Chief*)

WASHINGTON—Specifications under the six-item educational orders program are being drawn up and will be ready to submit to bidders within three weeks. Bidders will be most carefully selected, in accordance with the law. Officers working on the plans tell *American Machinist* that only firms having the highest qualifications for the work involved need expect to be asked for bids. They also say that while the law gives some persons the impression that contracts will be let entirely on the basis of negotiation, a considerable element of competitive bidding is actually maintained. Painstaking preparation of specifications is necessary to achieve the desired result. There is no indication as yet whether more items will be added. Repeating the list once more: .30 automatic rifles; 3-in. gun recoil mechanism; forging for 75mm shell; machining for the same; gas masks; 60-in. search lights.

Steel Wage Rates Ready

Walsh-Healey board's final draft of iron and steel minimum wage recommendations is about completed. It will be mimeographed and probably will go in the mail to some 300 companies, operating about 450 plants. The recommendation will go also to a dozen trade associations and to quite a number of companies allied with iron and steel in some way. It is a ponderous document of some 200 pages; about 600 copies will be sent out.

More Loans for Better Business

Reconstruction Finance Corporation in August authorized loans to business enterprises, purchases of participations, etc., totaling $23,577,791, as compared with a total of $21,825,480 in July. Outstanding August loans to metal-working firms: Waterbury Lock & Specialty $50,000; Maddox Foundry & Machine Works $12,000; Ebaloy Foundries $25,000; Midwest Tool & Manufacturing Company $40,000; Graham-Paige Motors $750,000; Berger Machine Company and Rex Metal Products $6,000; E. W. Ferry Screw Products $26,000; Crescent Machine Company $40,000; American Cotter Pin Company $27,500.

The August increase is due to several causes. Mainly, business got better and manufacturers saw their way clear to make commitments with some hope of repayment and profit. RFC activity increased somewhat under the April Glass Amendment, and that is just now coming out of the mill. There has been some delay inside of RFC too. Many of the loans disbursed in August were authorized at some previous time, so that listings in any one month do not necessarily serve as an indicator.

Andrews Moving Carefully

Wage-hour administrator Elmer Andrews is going ahead carefully and slowly, so far with friendly approval of labor and employers. He plans to appoint not more than four industrial committees this year, including textiles and tobacco. Probably the other two will be in clothing occupations. Meanwhile he is giving much energy and most of his meagre 1938 fund—$350,000—to setting up of a national compliance organization. This will consist largely of local labor officials already on the public payroll, instead of a host of new federal agents. His one big headache right now is uncertainty as to coverage of the law. The act does not define interstate commerce, and a great many borderline firms are inquiring whether they must comply with the statutory 25-cent 44-hour standard. Andrews and his new general counsel, Professor Calvert Magruder, Harvard faculty lawyer, don't know for sure. They can only advise that those in doubt had better comply, because if they don't and the courts later find them under jurisdiction they might be ordered to pay back wages.

Aircraft Wages too High?

Vigorous objections to the 60-cent maximum wage recommended by the Walsh-Healey board for the aircraft manufacturing industry were filed by the Aeronautical Chamber of Commerce here following rehearing. The chamber submitted much data to show that the beginning rate for aircraft workers is 40 cents, applying to a large proportion of employees. It was argued also that the 40-cent jobs were worth no more than that to the companies. They say that the 60-cent wage, if finally ordered, will raise the cost of airplanes to airline operators as well as to military services, since production costs cannot be separated in most plants. The Aeronautical Chamber said the Labor Department ignored the law, which requires that "going" wages be maintained. Other observers say the board is "hanging one" on the industry under union pressure, the unions believing that builders are panning rich gold out of heavy exports to foreign countries for their armament races.

UNITED WE STAND

Tremendously increased appropriations are assured by the federal government for all kinds of preparedness—army ordnance, airplanes, cargo ships, fighting ships, tanks, motorized equipment—everything conceivable that would be needed in war time.

Even the old "Little Navy" crowd of the Middle West, to whom forty millions for a battleship meant just that much less local pork, is on the preparedness side now. Every variety of liberal and progressive wants the United States to be ready.

Also there is no strong minority now, in the United States, which is belligerently on the "other side." In 1914 the contrast was startling. Numerically and politically the element at the outbreak of the last world war which favored the Central Powers was potent, although a minority. This time even the German language newspapers are critical of Hitler. The net result is that on Capitol Hill there is almost a unanimous sentiment for all the preparedness President Roosevelt may recommend. Even the pacifists are for it as the safest guarantee against any nation goading the U. S. into war.

PERSONALS

O. M. GIBSON

C. S. COGGESHALL

J. R. WEAVER

O. M. GIBSON, former Dodge metallurgist, has been appointed research director of G. S. Rogers & Co., Chicago, manufacturers of processing materials used in the heat-treatment and finishing of steel and automotive parts.

A graduate of the University of Detroit, Mr. Gibson was formerly field metallurgical engineer for J. B. Ford & Co., and later manager of the metal-working research department, E. F. Houghton & Co., Philadelphia. He is a member of the American Society for Metals and of several other technical societies, and for the past fifteen years has specialized in costs control as applied to the heat-treatment and general manufacture of automobile and machinery parts.

CLAYTON S. COGGESHALL has been named manager of the turbine division, central station department, General Electric Co. His appointment to succeed the late ROBERT B. BEALE was announced by M. O. TROY, commercial vice-president.

After his graduation from Cornell in 1911, Mr. Coggeshall enrolled in the G. E. student engineering course at Schenectady. In 1915 he became associated with the turbine sales department, and three years later took charge of the turbine sales office at Lynn, Mass. Since March 1 of this year he has served as general assistant to Mr. Beale.

JAMES R. WEAVER, director of equipment, inspection and test for the Westinghouse Electric & Mfg. Co., in addition to his present duties will be responsible for equipment negotiations, it was announced by T. I. PHILLIPS, works manager.

Mr. Weaver entered the employ of the company in 1915, later serving as assistant works mechanical engineer, superintendent of manufacturing equipment and equipment engineer. In 1936 he was appointed director of equipment, inspection and test, being responsible for the selection and development of machine tools as utilized by the company. In his new capacity he will also be responsible for negotiating and purchasing capital account equipment, his headquarters remaining at East Pittsburgh.

B. C. BUDD, vice-president of the Packard Motors Export Corp., H. M. SALISBURY, export sales manager, Nash Motors division, Nash-Kelvinator Corp., and C. B. THOMAS, general sales manager, export division, Chrysler Corp., have sailed for Europe where they will discuss automotive trade expansion plans with foreign representatives of American factories. The first conference, to be held at the Hotel Claridge in Paris on Oct. 10, will be broadly promotional on behalf of the industry as a whole.

CHARLES K. FOSTER, vice-president, American Radiator Co., replaces FOWLER MANNING, resigned, as president, Standard Air Conditioning Co., a subsidiary of American. WILLIAM H. BAKER was named general manager with offices in New York.

PAUL G. HOFFMAN, president of the Studebaker Corp. and of the Automotive Safety Foundation, has been appointed a member of the public relations committee of the Automoble Manufacturers Association.

GEORGE E. KUMMEROW has been made manager of the Chicago branch, Owens-Illinois Can Co. He has been associated with Continental Can Co. for the past nineteen years, the last five as Chicago sales manager.

HERMAN R. LARSON has been appointed central district service manager of the Westinghouse Electric & Mfg. Co. with headquarters at the Homewood works, according to an announcement by H. F. BOE, service department manager. With the exception of the year 1920, when he was located in the generator test division, Mr. Larson has been continuously in the service department since joining the company in 1919.

AVERY PHILLIS has been appointed district manager of the western sales territory of Beaver Pipe Tools, Inc. Mr. Phillis succeeds W. S. ANDREWS, who has resigned to accept a position with the Equitable Meter Co. of Pittsburgh.

R. A. VAN HAKE, formerly factory superintendent, has been appointed works manager of the Lockheed Aircraft Corp. plant at Burbank, Cal.

BUSINESS ITEMS

Bower Roller Bearing Co., Detroit, has made a ten-year contract with Ahlberg Bearing Co., Chicago, whereby the latter becomes its industrial sales representatives. S. A. STRICKLAND, president of Bower, has been made a director of Ahlberg Bearing.

The Los Angeles plant of the Lockheed Aircraft Corp. is being tooled to turn out 200 reconnaisance bombers ordered recently by the British Air Ministry.

The management and operation of the Interstate Aircraft & Engineering Corp., one of California's largest aircraft parts manufacturers, have been taken over by D. P. SMITH, L. B. CAMERON and W. E. HIRTENSTEINER, former Aviation Mfg. Corp. officials.

The Economy Electric Lantern Co. has leased quarters at 3100 W. Cherry St., Milwaukee and about October 15 will begin manufacture of an electric lantern formerly made by Metalware Corp., Two Rivers, Wis., under contract with K. J. HELMHOLTZ, inventor, Chicago. CARL SIBENHORN, formerly factory superintendent, Metalware Corp., will be in charge of production.

The General Water Heater Co., of Hollywood, Cal., has been issued a permit for the construction of a new factory building in Burbank. The structure will cost $50,000.

The John Deere Plow Co. is doubling the size of its Toledo warehouse and sales headquarters.

The Marino electro-galvanizing process, which has been employed in production in England for the past five years, will be handled in the United States by GEORGE D. HARTLEY of Worcester, Mass. Since no heat is used in this process, which combines electro-cleaning, pickling and galvanizing in a series of automatic operations, many advantages are claimed for it.

M. P. McCaffrey, Inc., construction machinery manufacturers, have moved to a new, modern plant in Los Angeles.

Mid-West Production Engineering, Inc., announces the appointment of FRANK L. PEABODY as sales agent in the northern New England states.

The National Automotive Fibers Co. of Los Angeles will soon build a warehouse costing $33,000.

North American Aviation, Inc., of Los Angeles, on Sept. 15 received an order amounting to over $300,000 for combat trainer planes from the United States Government. The planes are to be equipped with a single 550-hp. Pratt & Whitney motor and carry a student and instructor. The company only recently received an order for over 200 ships of a similar type from the Navy Department and an order for 200 more from the British Air Ministry.

The USL Battery Corporation will devote the entire facilities of its Niagara Falls plant to the manufacture of automotive, radio and farm lighting batteries, the industrial battery division being dis-

continued immediately. The change was necessitated by a substantial increase in the volume of automotive battery business.

Arrangements have been made for the Gould Storage Battery Corp., Depew, N. Y., to acquire the USL power battery department and to continue inspection and replacement service covering USL batteries now in the field.

The Thomson-Gibb Electric Welding Co. of Lynn, Mass., has established offices in Philadelphia under the supervision of WILLIAM H. GIBB.

Trace & Warner, industrial designers, are now in their new offices at 155 N. Clark St., Chicago, Ill.

OBITUARIES

WILLIAM A. COWLES, vice-president of the American Brass Co., Ansonia, Conn., died at the age of 79. Mr. Cowles was also president of the Ansonia National Bank, vice-president of the Ansonia Water Co. and a director of the Derby Gas & Electric Co. He began with the Ansonia Brass & Copper Co. in 1879 and became vice-president when that company merged with the American Brass Co.

GUSTAV ALBERT ENGLUND, 69, vice-president and factory manager of the Jacobs Mfg. Co., Hartford machine tool manufacturer, died Sept. 16 of a cerebral hemorrhage. He was with the Jacobs Company for 25 years.

WALTER W. FIELD, president and general manager of Walter W. Field & Son, Inc., Cambridge, Mass., and formerly general superintendent of the Kendall & Roberts shops of that city died at Boston on Sept. 17. He was born in Tonawanda, N. Y., 85 years ago.

FRANK D. FULLER, president of the Moore Drop Forging Co., Springfield, Mass., died Sept. 25. Mr. Fuller was a leading industrialist and a member of the former NRA Code Authority for the forging industry.

RUSSELL GARDNER, retired automobile manufacturer, died Sept. 17 at his Memphis home at the age of 72. Mr. Gardner was one of the country's best known buggy makers and later turned to the manufacture of the Gardner automobile.

JOHN R. GRIFFITH, of the Norton Company's electric furnace plant at Chippewa, Ontario, died at the age of 56.

RICHARD KELLY, former president of R. Hoe & Co., world's largest manufacturer of newspaper printing presses, died at his home in New York City following a month's illness. He was 69 years old.

CLIFTON REEVES, 62, president of the Reeves Engine Co., died Sept. 21 of a heart attack at his home near Trenton, N. J. An inventor and designer for the past 40 years, he also organized the Lea Degen Pump Co., the Reeves-Cubberly Engine Co. and the Reeves Foundry Co.

ALBERT P. WOOD, Atlanta machinery manufacturer, died at the age of 72 after an extended illness.

CHARLES E. DURYEA

CHARLES E. DURYEA, widely credited as being "the father of the automobile," died Sept. 28 at his home in Philadelphia. His death at the age of 77 followed a long illness.

Born in 1861, he built his first bicycle at the age of seventeen from parts of discarded farm implements. Four years later he wrote a graduation thesis, "Rapid Transit Other than on Rails," in which he predicted half-day transoceanic flights. Thereafter he engaged in the bicycle business, taking out patents on numerous inventions.

In 1888 Mr. Duryea acted as consultant in the development of a steam car, and from that time his interest in the "horseless carriage" was intense. By 1893 he had successfully operated gasoline-powered buggies in Springfield, Mass., and two years later was manufacturing cars on a commercial basis. None of his varied models caught the public fancy, however, and their production was discontinued in 1914. Although in his later years he acted as a consultant on engineering and on matters of automobile history, his talents seemed to lie in the field of pure invention, and he died comparatively poor.

For many years a brisk controversy raged as to the actual origin of the first American automobile. The honor was claimed on behalf of the late Elwood Haynes, and a Haynes car was accepted by the Smithsonian Institute as the pioneer. Subsequently Duryea's first car was also placed in the museum and credited to him.

ARTHUR W. SAVAGE, 83, retired arms manufacturer and inventor of the repeating rifle bearing his name, committed suicide in San Diego, Cal., Sept 23. He left a message saying the only reason for his action was unbearable pain from continued illness.

WILLIAM A. SCHENDEL, president, Atlas Metal Parts Co., Milwaukee, died Sept. 16 at the age of 53. He had founded the company in 1918 and had served as purchasing agent, A. O. Smith Corp., from 1908 to 1936.

CHARLES H. SCHEERBAUM, purchasing agent for the Abrasive Co., division of Simonds Saw & Steel Co., died in Philadelphia Sept. 8.

GEORGE M. TILDEN, tool manufacturer, died recently at his home in Los Angeles at the age of 64.

MEETINGS

AMERICAN GAS ASSOCIATION. Twentieth annual convention, Oct. 10-13, Atlantic City, N. J. ALEXANDER FORWARD, managing director, 420 Lexington Ave., New York City.

AMERICAN GEAR MANUFACTURERS ASSOCIATION, Skytop Lodge, Pocono Mountains, Pa., Oct. 10, 11 and 12. Secretary of the Association: J. C. MCQUISTON, Shields Building, Wilkinsburg, Pa.

AMERICAN MANAGEMENT ASSOCIATION. Production conference, Hotel Pennsylvania, New York City, Nov. 9 and 10.

AMERICAN SOCIETY FOR METALS. Twentieth Annual Metal Congress and Exposition, Statler Hotel and Convention Hall, Detroit, Oct. 17-21. W. H. EISENMAN, secretary, 7016 Euclid Ave., Cleveland, Ohio.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS. First Fall meeting, Biltmore Hotel, Providence, R. I., Oct. 5-7. Society secretary, C. E. DAVIES, 29 W. 39 St., New York City.

AMERICAN SOCIETY OF TOOL ENGINEERS. Semi-annual meeting, Oct. 14-15. Pittsburgh, Pa. FORD R. LAMB, executive secretary, 2567 W. Grand Blvd., Detroit.

AMERICAN WELDING SOCIETY, Nineteenth Annual Meeting, Book-Cadillac Hotel, Detroit, Mich., Oct. 16-21. Society secretary, M. M. KELLY, 29 W. 39 St., New York City.

ASSOCIATED MACHINE TOOL DEALERS OF AMERICA. Annual convention, Cincinnati, Ohio, Oct. 10 and 11. Convention headquarters at Hotel Alms. Executive secretary, THOMAS A. FERNLEY, JR., 505 Arch St., Philadelphia, Pa.

NATIONAL ASSOCIATION OF FOREMEN, Dayton, Ohio, October 14, 15 and 16.

NATIONAL AUTOMOBILE SHOW, Grand Central Palace, New York, N. Y., beginning Nov. 11.

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION, Annual Meeting, Oct. 24-28. Palmer House, Chicago. J. W. DONALD, managing director, 155 E. 44 St., New York City.

NATIONAL FOREIGN TRADE CONVENTION. Machinery group meeting, Hotel Commodore, New York City, Oct. 31-Nov. 2. Group program chairman: LEWIS M. LIND, Machinery Diviesion, Bureau of Foreign and Domestic Commerce, Washington, D. C.

NATIONAL SAFETY COUNCIL. National Safety Congress, Oct. 10-14. Stevens Hotel, Chicago. Council secretary, H. J. GRIFFITH, Jones & Laughlin Steel Corp., Pittsburgh.

PORCELAIN ENAMEL INSTITUTE. Third annual forum, October 12-14. University of Illinois, Urbana, Illinois. Committee Chairman, F. E. HODEK, JR., General Porcelain Enameling & Manufacturing Co.

Eighth annual meeting, October 25 and 26. Cleveland.

SOCIETY OF AUTOMOTIVE ENGINEERS.

National aircraft production meeting, Oct. 13-15, Ambassador Hotel, Los Angeles, Calif.

SHOP EQUIPMENT NEWS

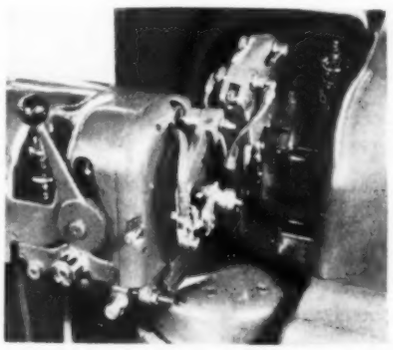
Landis No. 2 "Race-A-Way" Grinder

The No. 2 "Race-A-Way" grinder, announced by Landis Tool Co., Waynesboro, Pa., may be tooled to internal grind the raceways of outer races or to external grind the raceways of inner races for ball bearings. When set up to do internal grinding, this machine has capacity to handle the smaller sizes up to and including the No. 212, 311 and 409 groups. Sizes up to and including the No. 218, 316 and 414 groups can be ground by the external unit. Both single and double roll races can be ground.

To maintain constantly a high-production rate, the entire grinding cycle is automatic once it has been set in motion. It is necessary only for the operator to load the work and depress the cycle start button. From that point on, the race automatically is ground to size and all machine movements stopped without further attention. An innovation is the provision made for form grinding each raceway during the sparking out period. When the work is practically to size the feeding-in movement and work oscillation movement stop with the work head centered. The wheel then sparks out without any oscillating motion. As a result, it is unnecessary to form grind races after they have been finished on this machine.

Movements of the machine are controlled by pushbuttons and selector switches, the cycle controls being arranged in such a manner as to permit the operator to use any portion of the cycle separately. A large master safety button will stop every machine movement instantaneously. The hydraulic wheel reset mechanism resets the wheel base automatically at the end of each grinding cycle, the amount of reset being adjustable and being equal to the amount of stock which is removed from each race.

Basically, the machine is the same whether tooled for internal or external grinding. The main differences are in the design of the sizing device and the work holding chuck, as well as in the size of the grinding wheel spindle and the wheel used. Automatic sizing is accomplished by means of the "Landis-Solex" sizing device in combination with an electric timing device. Preloaded ball bearings carry the large oscillating column and the work spindle revolves in previsions, preloaded ball bearings. Oscillating movement of the workhead is actuated mechanically through an adjustable crank arrangement. Four oscillating speeds are available.

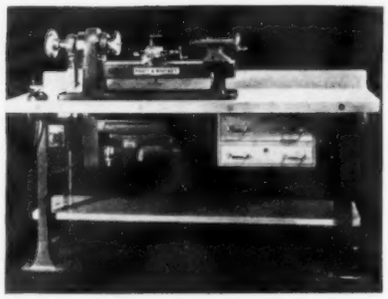


Anti-friction bearing mounted wheel spindle is mounted within an octagon slide, four sides of which are used as bearing surfaces

Work drive motor is mounted on the lower end of the oscillating column on the exact center of the column. From this motor, the drive is to the left-hand end of the work spindle through a V-belt with no intermediate pulleys or idlers. Adjustable pitch pulleys are used to give a wide work-speed ratio. For grinding double row races, a lever with rack and pinion is provided so that the slide carrying the work head may be moved between two adjustable stops. Separate compartments in the bed house the various mechanisms.

Wheel base of the "Race-A-Way" grinder is moved in and out of grinding position by means of a crank motion actuated by a hydraulic motor. The outside of the bed of this machine is devoid of attachments

P. & W. 7 x 16-In. Improved Bench Lathe



Designed primarily for precision work in tool rooms and experimental laboratories, the 7 x 16-in. bench lathe announced by Pratt & Whitney Div., Niles-Bement-Pond Co., Hartford, Conn., is equipped with a camlock spindle nose. There are no threads to be damaged or to catch dirt or chips when mounting a chuck or face plate on the spindle. Spindles are mounted on preloaded precision ball bearings, permanently lubricated and sealed. Drive is from a Transitorq unit through multiple V-belts to give an infinite number of spindle speeds within the specified range. Heavy tailstock spindle is graduated for drilling to depth.

Specifications: length of bed 33½ in.; maximum center distance, 16 in.; diameter of swing over bed, 7 in.; collet capacity, ¾ in.; tailstock spindle travel, 2¾ in.; travel of tool slide, 4¼ in.; travel of cross slide, 4 in.; diameter of dog driver plate, 4½ in.; selective spindle speeds with ½ hp. motor drive, 150-1,500 r.p.m.; selective spindle speds with ¾ hp. motor drive, 225-2,250 r.p.m.; net weight of machine with regular equipment, 305 lb. A wide range of standard and special equipment is available for use with this machine.

Ex-Cell-O Style No. 31 Grinder Will Grind Threads 22-In. Long

If straight threads are to be ground, the No. 31 thread grinder announced by Ex-Cell-O Corp., 1228 Oakman Blvd., Detroit, Mich., will handle work up to 6-in. in diameter. With the taper attachment, work up to 5-in. in diameter may be ground. Threads can be ground up to 22-in. in length on work up to 36-in. long between centers. This model has a long master lead screw inclosed in a housing extending beyond the left end of the grinder, while the work carrying table is designed to feed to the right of the machine. Short lead screws designed for use on the original No. 31 grinder also may be used. This permits grinding short threads on the same machine without making special lead screws.

Work table is supported on a subbase and rides on hardened, ground, and lapped steel rollers. The lead screw carrying spindle is supported at the table end in two precision bearings. Drive is from a two-speed motor through worm gearing. When drive is from an a.c. motor, two-step interchangeable pulleys for both wheel and motor spindles are furnished, making it possible to maintain surface grinding speed as the grinding wheel wears down in service from the original 18-in. size to a minimum of 12-in. diameter. Machine may be equipped with d.c. motors, in which case speed changes are taken care of through 24 steps on the rheostat to provide speed variations of from 1,485 to 2,640 r.p.m. in steps of 48 r.p.m. The machine is designed to grind in both directions and wheels can be dressed without slowing down the wheel, insuring accurate dressing under actual operating conditions. Machine may be set either to stop or to reverse automatically at the end of each stroke.

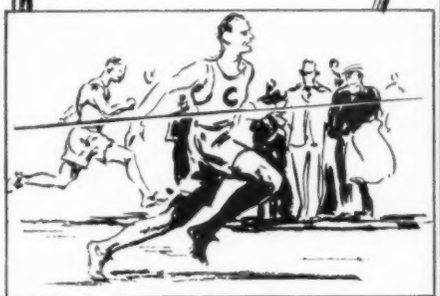
Verson No. 860 Full-Eccentric Press

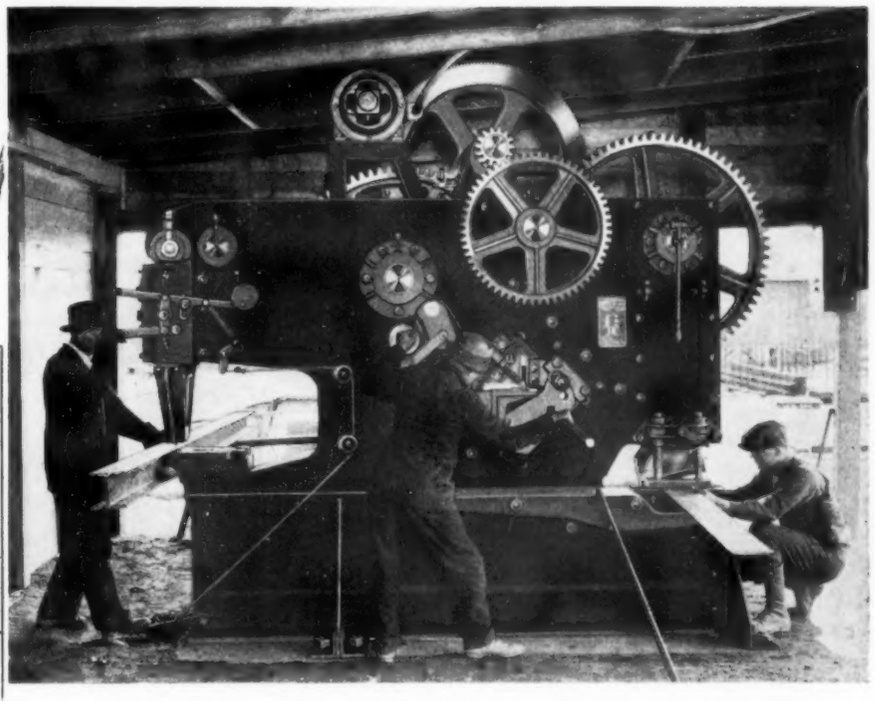
Distance between housings, which is the same as the distance between gibs, in the 300-ton capacity No. 860 full-eccentric press announced by Verson Allsteel Press Co., 9306 S. Kenwood Ave., Chicago, Ill., is 60 in. This type of press does not use a crankshaft, and all moving parts, except the flywheel and clutch, are contained within the crown. Frame is of all-steel welded construction. Clutch, which is air actuated, and the disk-type friction brake work in unison. These presses are available in the solid-frame type shown in capacities ranging from 100 to 500 tons in both singe- and double-suspension types.

"High-Speed" Improved Wide-Gap Hammers

Improved wide-gap riveting hammers have been developed by The High Speed Hammer Co., Inc., 305-321 Norton St., Rochester, N. Y., for cold riveting parts where rivets are

AS VERSATILE as a Decathlon CHAMPION





If you want to get things done in your fabricating departments, don't try to get along without a Buffalo Universal Diagonal Punch, Shear, and Bar Cutter. As the picture shows, here is a machine that does several entirely different operations all at once and much better and faster than can be done by ordinary methods. It handles Angles, Tees, Rounds, Squares, Flats — does punching, shearing, slitting, coping, notching.

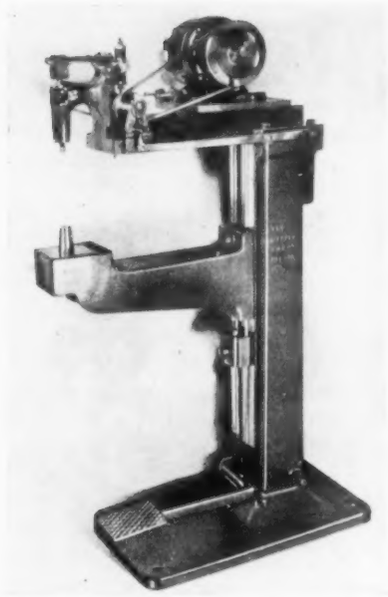
The frames are made of "Armor-Plate" electrically welded steel.

There are a wide range of sizes. Why not send for our Bulletin 331 now—and make your iron working department more versatile, more profitable!

BUFFALO FORGE COMPANY
448 BROADWAY BUFFALO, N. Y.

Branch Engineering Offices in Principal Cities
In Canada: Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

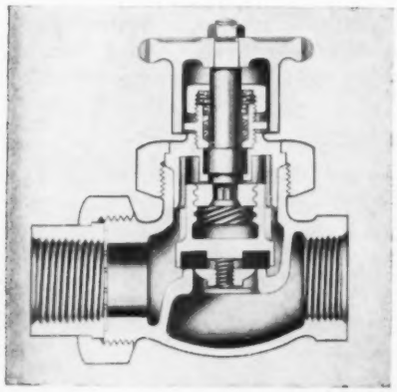
"Buffalo" U.D. PUNCHES, SHEARS *and* BAR CUTTERS



located a considerable distance from the edge of the work. The two additional sizes now offered are the No. 1AA and No. 1½B, both of which have a range up to a ⅛ in. diameter mild steel rivet. The machine shown has an 18-in. horizontal gap. Wider gaps can be furnished if required. All moveable parts are interchangeable with standard hammers of the same capacity.

Crane No. 237 Brass Globe Valve

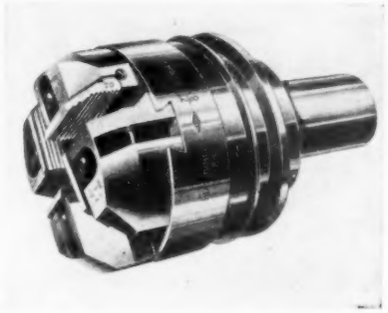
Developed especially for installations on air lines where quick-opening, quick-closing valves are required, the No. 237 brass globe valve offered by Crane Co., 836 S. Michigan Ave., Chicago, Ill., is made in ¾ and 1-in. sizes. It is recommended for 150 lb. per sq. in. air working pressure. An apron on the wheel protects the upper part of the valve from rough handling and a brass screen in the union connection at the valve inlet keeps out foreign matter.



"Landex" Die Heads For Special Operations

The Type L "Landex" die head shown has been adapted for a special production threading operation by the Landis Machine Co. Inc., Waynesboro, Pa. The part to be threaded has a sharp bend immediately back of the threaded section, making it difficult to use a die head of a sufficient capacity to handle the required diameter.

A set of wide chasers were milled off at an angle to clear the bend in the part and the chaser holders were beveled to eliminate interference during the threading operation, no other changes were necessary.



Reed-Prentice Four-Way Hydraulic Unit Machines Universal Joint Spiders

Approximately 20 sec. are required for turning, chamfering, facing and centering universal joint spiders complete in the four-way hydraulic machine recently announced by Reed-Prentice Corp., Worcester, Mass. This machine is equipped with an electrically operated hydraulic mechanism which provides rapid approach and rapid return to the spindles. Fixture also is hydraulically operated for rapidly clamping the work into position. At the end of the operation cycle, the clamp automatically is released, thus allowing the operator to remove the finished piece and replace it with the next spider.

Each spindle is independently driven by a 3 hp., 1200 r.p.m. motor. Spindle speed is 500 r.p.m. and feeds range from 0.008 to 0.0028 in. per

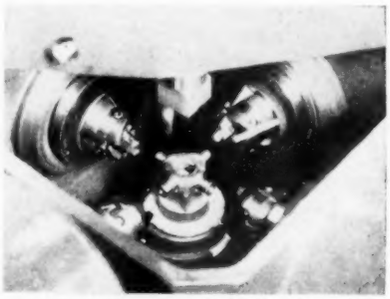


Fig. 2—Fixture for holding the spiders is actuated hydraulically and is released automatically at the end of each cycle

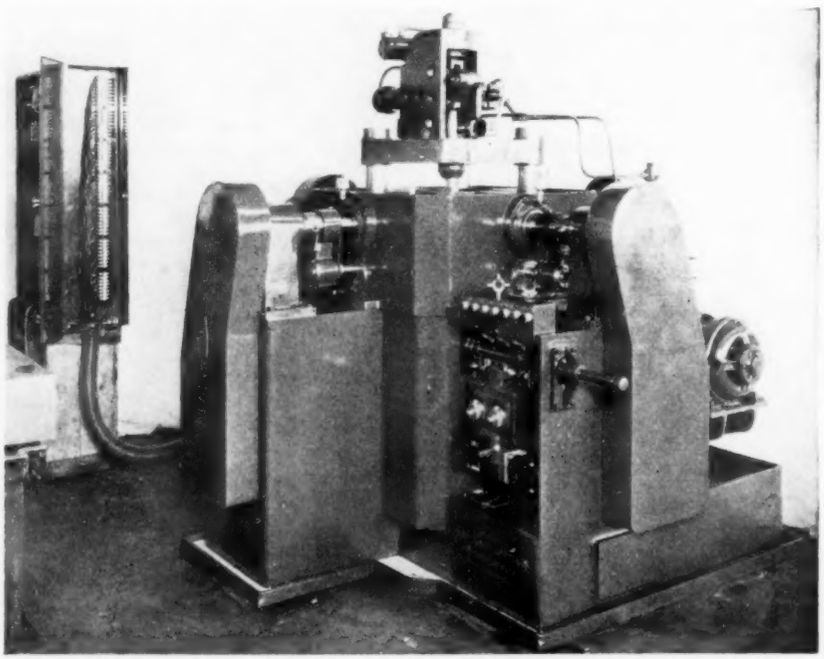
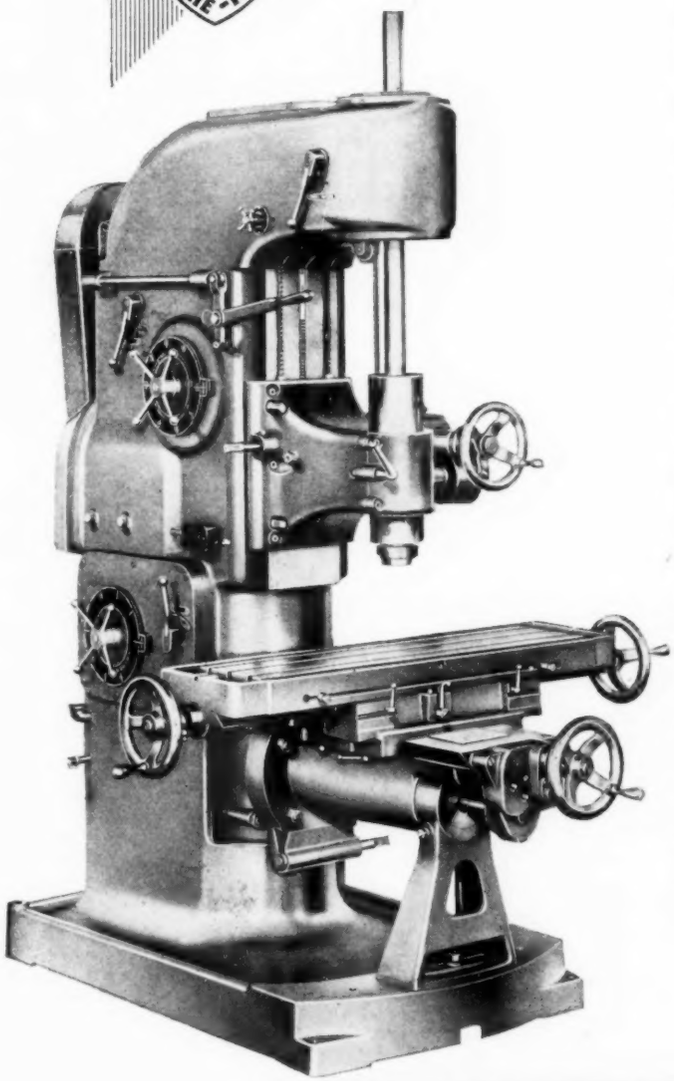


Fig. 1—Universal joint spiders are turned, chamfered, faced and centered complete at the rate of three a minute in this hydraulically-fed machine built by Reed-Prentice

	QUALITY JOB	SAVINGS IN TIME	LOW COST	GOOD WAGES	SAFETY	EASY OPERATION	PROFITS
YOUR CUSTOMER	✓	✓	✓				
YOUR EMPLOYEE	✓			✓	✓	✓	
YOU	✓	✓	✓				✓

KNIGHT VERSATILE MILLERS ACCURATE RIGID

CHECK THIS CHART TO SEE HOW THE KNIGHT MILLER *benefits all three*



★ The Knight Miller is a most important tool for those who seek to check with the above chart. The answer is in the ability of this modern machine tool to accomplish satisfactory results in quickest time, with the least amount of equipment, at savings in cost, and with least effort for the operator.

All three also benefit because of the greater power and accuracy, the Knight fast method of changing cutting tools—the elimination of many hours of layout time—the reduction of the operator's machine handling time—and a vast number of other reasons.

To learn more about these Knight advantages, write for bulletin giving complete details. You will find it interesting.

●

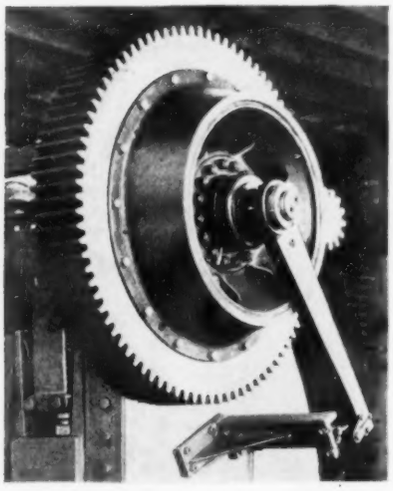
W. B. KNIGHT MACHINERY CO.
• ST. LOUIS, MISSOURI •

rev. Loading time is 1 3/5 sec. and rapid approach through hydraulic feed consumes 2½ sec. All steps in the cycle are controlled electrically. Machine is equipped with a motor-driven coolant pump and ample facilities for removing chips.

I.C. "Servo-Action" Friction Press Clutch

Developed especially for use on punch presses, the "Servo-Action" friction clutch offered by The Industrial Clutch Co., Waukesha, Wis., has been engineered specifically to meet the requirements of punch press service and is not recommended for replacing clutches on presses now in use.

The servo-mechanism forms the hub of the inner clutch cone and both engagement and release of the

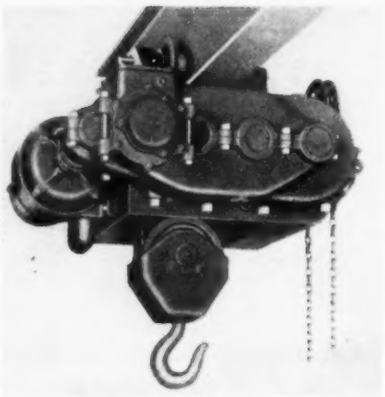


clutch are made without shock in successive, rapidly taken steps. Clutch elements can be connected temporarily to rotate in either direction for changing or setting dies. Full effect of the Servo-Action is developed when the punch or die parts strike the metal. At that instant, the resulting torque on the helical splines forces the friction surfaces into high pressure engagement.

Northern "Hi-Lift" Improved Hoists

"Hi-Lift" hoists developed by Northern Engineering Works, 210 Chene St., Detroit, Mich., are available in capacities ranging from 3 to 5 tons and can be equipped either with hand-traveled or motor-operated trolleys. Standard hoisting speed with a 3-ton load is 20 ft. per min.

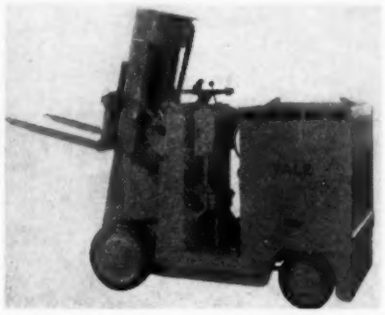
Various types of control are available and the hoist can be powered



with a.c. or d.c. equipment. The distance between the center of the hook in its highest position and the bottom of the Monorail beam has been held to a minimum.

"Yale" Model K-41 Center-Control Truck

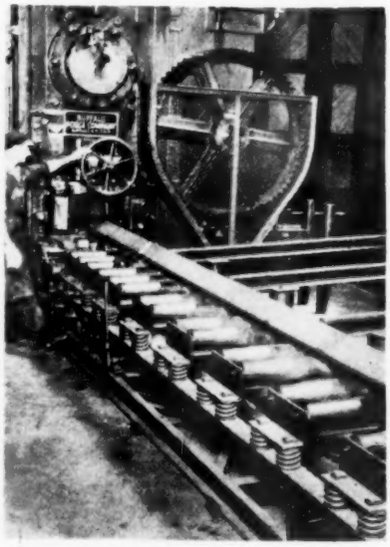
The Yale & Towne Mfg. Co., 4530 Tacony St., Philadelphia, Pa., offers the "Yale" Model K-41 center-control tilting fork truck for use where increased maneuverability in operation is required. This truck has a capacity of 5,000-6,000 lb. It has a minimum over-all height of 83 in. and is capable of elevating the forks to a maximum height, in raised position, of 102¾ in. The truck can go through 7-ft. doorways, yet is cap-



able of stacking merchandise to ceiling height. The upright channel frame is tilted back 10 deg. and forward 5 deg. by two racks which pass over driving pinions.

Mathews Bar Shear Conveyor Table

Mathews Conveyor Co., Ellwood City, Pa., has developed a bar shear conveyor table which is arranged to handle bars up to 17 ft. long and having a maximum weight of 2,000 lb Heavy-duty ball bearing rollers mounted on springs, are used to provide a mobile surface that will stand the abuse encountered. Screw jacks are provided under each end of the table and connected by a through shaft and bevel gears to provide for raising and lowering the entire table to various elevations. A power-driven grooved wheel is mounted on a screw to permit adjustment across the width of the shear. This grooved wheel furnishes the necessary means for feeding and guiding the heavy bar stock into the shear.



Sterling "Gyro" Electric Sander

Movement of the sanding pad on the "Gyro" electric sander announced by Sterling Products Co., 2457 Woodward Ave., Detroit, Mich., is said to closely simulate hand sanding motions. Abrasive paper attached to the bottom of the pad has a movement in which each particle of abrasive moves in a centroid of approximately $\frac{5}{16}$ in.

Machine is driven by a ¼ hp.,

LUBRICATION SCIENTIFICALLY APPLIED THRU THE USE OF OILITE

HOW . . . . . .

Due to the inherent sponge-like nature of OILITE bearings, they generate their own oil film and meter the oil as required without any dripping whatsoever. The capillary action of OILITE conveys oil directly through the wall to the bearing surface, providing a complete oil cushion at every point.

WHY . . . . . .

OILITE bearings are made by combining chemically pure virgin copper, tin and graphite. In their finished state they might be described as a metal like a sponge, but a sponge so fine that the pores are almost invisible. They will soak up as much as 35% of their volume in oil, yet they are so strong they are used for locomotive bearings.

WHEN . . . . . .

Assume that a shaft rests in an OILITE bearing; as soon as there is frictional heat, or pressure is exerted, the oil rushes to the surface of the bearing in just the right quantity. When the motion stops, or the pressure is removed, the oil disappears into the apparently solid metal from which it came.

Demonstrating the amazing OILITE pressure test, the vise and water tests above show how lubricant flows to the surface of the bearing the instant it is needed. Release the pressure entirely and like magic the oil begins to disappear. The surface that was so oily only a moment ago is just like a piece of ordinary metal. The oil has gone right back into it. Incidentally, it took more than four tons pressure to distort the bearing shown in the vise test.

250 sizes of plain cylindrical, flanged and thrust types of OILITE bearings are in stock ready for your use. Send for your copy of Catalog 4-38 which contains complete specifications and prices of these bearings.

OILITE BRONZE BEARINGS CARRIED IN STOCK AT

AKRON, OHIO
The Manufacturers Rubber & Supply Co.

ALBANY, NEW YORK
Sager-Spuck Supply Co., Inc.

ALLENTOWN, PENNSYLVANIA
Wm. H. Taylor & Company

ATLANTA, GEORGIA
J. M. Tull Metal & Supply Co.

BALTIMORE, MARYLAND
Carey Machinery & Supply Co.

BOSTON, MASSACHUSETTS
Boston Gear Works, Inc.
Chandler & Farquhar Co., Inc.
Lewis E. Tracy Company

BRIDGEPORT, CONNECTICUT
Hawley Hardware Company

BRONX, NEW YORK
Bronx Hardware & Supply Co., Inc.

BROOKLYN, NEW YORK
H. L. Dickie

BUFFALO, NEW YORK
Root, Neal & Company

CANTON, OHIO
The Manufacturers Rubber & Supply Co.

CHARLOTTE, NORTH CAROLINA
Mathews-Morse Sales Co.

CHICAGO, ILLINOIS
Boston Gear Works, Inc.
H. Channon Company
Chicago Pulley and Shafting Co.
Samuel Harris & Co.
Ray M. Ring Co.

CINCINNATI, OHIO
The Queen City Supply Co.

CLEVELAND, OHIO
Bearing-Distributors, Inc.
Boston Gear Works, Inc.

DES MOINES, IOWA
Standard Bearings Co.

DETROIT, MICHIGAN
The Chas. A. Strelinger Co.

GREENSBORO, NORTH CAROLINA
Odell Mill Supply Co.

HARTFORD, CONNECTICUT
Silliter-Holden, Inc.

INDIANAPOLIS, INDIANA
Vonnegut Hardware Company

LOUISVILLE, KENTUCKY
Industrial Equipment Co.

MILWAUKEE, WISCONSIN
The Western Iron Stores Co.

MINNEAPOLIS, MINNESOTA
R. C. Duncan Company

MONTREAL, QUEBEC, CANADA
R & M Bearings Canada Ltd.

MUSKEGON, MICHIGAN
Muskegon Hardware & Supply Co.

NEWARK, NEW JERSEY
Squier, Schilling & Skiff

NEW BRITAIN, CONNECTICUT
Smith & Klebes, Inc.

NEW HAVEN, CONNECTICUT
The C. S. Mersick Company

NEW YORK, NEW YORK
L. C. Biglow & Co., Inc.
Boston Gear Works, Inc.

PEORIA, ILLINOIS
Couch & Heyle, Inc.

PHILADELPHIA, PENNSYLVANIA
Boston Gear Works, Inc.
Maddock & Company

PITTSBURGH, PENNSYLVANIA
Somers, Fitler & Todd Co.

PROVIDENCE, RHODE ISLAND
Machine Parts Corporation

RICHMOND, VIRGINIA
Apex Machine Manufacturing Co.

ROANOKE, VIRGINIA
Noland Company, Inc.

ROCHESTER, NEW YORK
John M. Forster Company

ST. LOUIS, MISSOURI
Colcord-Wright Machinery & Supply Co.

SPRINGFIELD, MASSACHUSETTS
Stacy Supply Company

SYRACUSE, NEW YORK
Syracuse Supply Company

TOLEDO, OHIO
The Ohio Belting Company

TORONTO, ONTARIO, CANADA
R & M Bearings Canada Ltd.

TRENTON, NEW JERSEY
Wiley-Hughes Supply Co.

VANCOUVER, B. C., CANADA
R & M Bearings Canada Ltd.

WORCESTER, MASSACHUSETTS
W. M. Steele Company

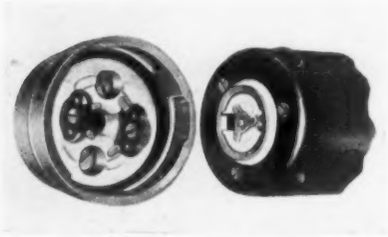
YORK, PENNSYLVANIA
Geo. F. Motter's Sons Supply Co.

BOSTON GEAR WORKS, INC. NORTH QUINCY, MASS.

3,450 r.p.m. electric motor and power is transmitted to the sander head by a flexible shaft. Motors can be arranged for bench mounting, suspended from the ceiling, or mounted on an adjustable pedestal, as shown. The sanding head weighs 3¼ lb.

Westinghouse "Locklite" Lighting Unit

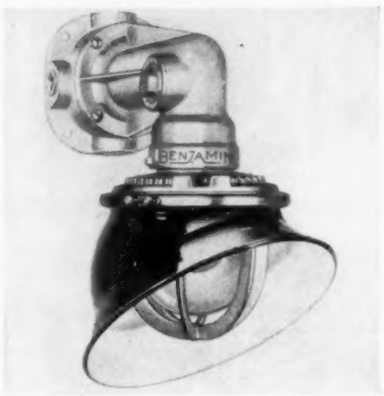
The "Locklite" principle of attaching industrial reflectors, announced by Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., makes it impossible to light the lamp until the reflector is locked properly into place.



Each unit consists of two parts, a hood and a receptacle into which the reflector with lamp holder fits. When the lugs on the neck of the reflector lock into the slots of the hood, the electrical connection is made. The hood is installed permanently and the reflector with lampholder is attached later.

K. & E. "Favorite" "Wyteface" Steel Tape

The "Favorite Wyteface" steel tape offered by Keuffel & Esser Co., Adams and Third St., Hoboken, N. J., has black graduations on a crack-proof white surface which are said to be easy to read, even in poor light. Elimination of the usual etching process is said to leave the steel at full strength, giving the tape a high resistance to kinks or curls. The white surface is firmly bonded to the steel. This tape is available in 25, 50, 75 and 100 ft. lengths.



Benjamin Angle-Type Explosion-Proof Units

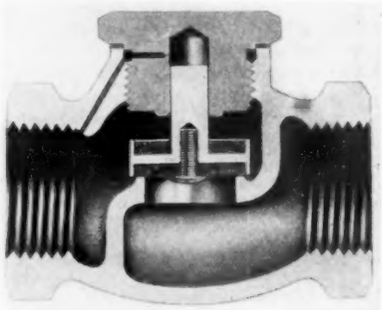
A series of angle-bracket type explosion-proof lighting fixtures, suitable for side wall mounting, has been developed by Benjamin Electric Mfg. Co., 120-128 Sangamon St., Des Plaines, Ill. These fixtures are available with enameled steel reflectors in dome, shalow dome, bowl and symmetrical angle shapes. They are listed by the Underwriters' Laboratories as suitable for hazardous locations in which flammable volatile liquid or other substances are stored.

Pangborn No. DD-4 Airblast Helmet

Designed to rest upon the shoulders of the wearer, the No. DD-4 helmet developed by Pangborn Corp., Hagerstown, Md., for sand and shotblast operators has been approved by the U. S. Department of Mines. This helmet is designed to be supplied continuously with respirable air from a suitable source. The wearer breathes the supplied air, rather than the air in the immediate vicinity. A detachable coupling in the air supply line is within easy reach of the wearer.

Norgren Chatterless Air Check Valve

Noise and vibration due to valve hammer in air lines are said to be reduced almost completely by a check valve developed by C. A. Norgren Co., Inc., Denver, Colo. The moving element of this valve is held in suspen-



sion, when the valve is open, by a suction created above the valve stem by the flow of air past a syphon hole in the valve body.

Jackson Type C Safety Eyeshield

A flexible, transparent and non-inflammable visor adjustably hinged to a light headgear make up the Type C eyeshield announced by Jackson Electrode Holder Co., 6553 Woodward Ave., Detroit, Mich. The visor is furnished in clear, smoked, light-green, dark-green or amber shades. No part of the visor rests on the nose or ears. It does not interfere with eyeglasses if they are worn.

"Miccro" Lacquer For Plating Racks

The Michigan Chrome Co., 6340 E. Jefferson Ave., Detroit, Mich., has developed two types of stop-off lacquers for insulating plating racks and for masking parts to be hard

A GREAT STEP FORWARD IN A FORWARD STEPPING INDUSTRY

With a capacity up to 1½" solid stock, spindle and gears mounted in anti-friction bearings and many other mechanical features found only in larger machines, the new "RAPIDUCTION JUNIOR" is a great step forward in the threading industry.

The "RAPIDUCTION JUNIOR" is so constructed that with die-head and carriage removed it can be adapted to chamfering, drilling, reaming, boring, tapping and many other jobs.

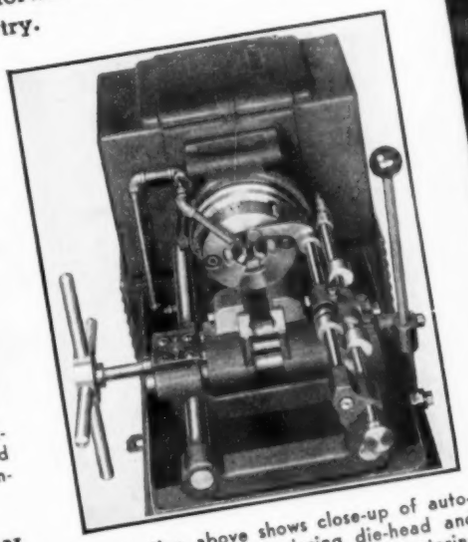


Illustration above shows close-up of automatic opening and closing die-head and stock-stop; open type, quick-centering vise; feed lever and rigidly supported ways on which carriage is mounted.

Investigate the "RAPIDUCTION JUNIOR" as a means of reducing your threading costs at the lowest possible initial investment. Get details and specifications today, from—

THE OSTER MANUFACTURING COMPANY

Sales office: 2049 East 61st Street, Cleveland, Ohio
Factories — Erie, Penna., and Cleveland, Ohio
New York City Office, 30 Church St.
Philadelphia Office, 111 No. 3rd St.

Threading Headquarters Since 1893

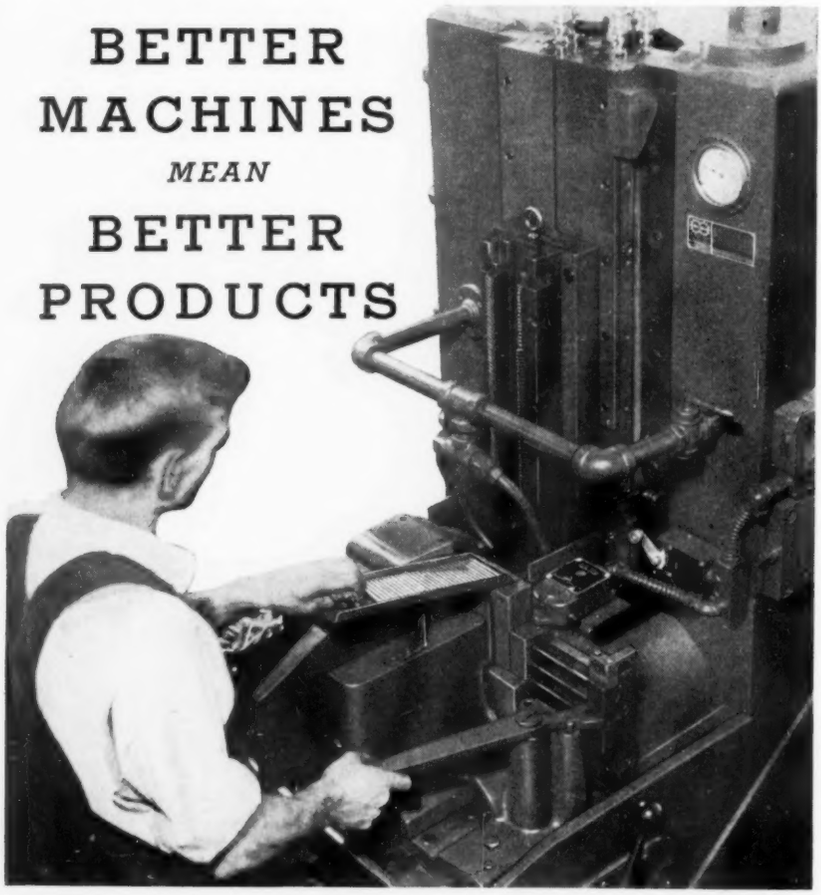
OSTER THREADING EQUIPMENT WILLIAMS

chromium plated. These are listed as "Miccro Supreme" lacquers and are applied directly on the metal surface; no preliminary treatment is necessary other than a thorough cleaning of the surface to be coated. Lacquers used for insulating plating racks are claimed to be practically unaffected through the regular cycle of decorative plating. They are effective for use in concentrated or diluted hydrochloric acid or sulphuric acid dips, cyanide or acid copper baths and chromic acid baths. They also are impervious to nitric or hydrofluoric acids. In use with hard chromium plating processes, the lacquers can be removed easily after plating, permitting thorough cleaning of all parts which have been coated with these materials.

Stoodex Free-Flowing Hard-Facing Rod

The Stoody Co., Whittier, Calif., has developed the "Stoodex" free-flowing welding rod for hard facing applications by the acetylene welding process. Deposits have an average hardness of 50 Rockwell C.

BETTER MACHINES *MEAN* BETTER PRODUCTS



● The trend in American Industry is sharply toward giving better value—by cutting costs, improving parts or the whole, by smoothing and speeding the way to production.

Only constant alertness—sharpest scrutiny of production methods can give a producer a place in this marching parade.

Production men, of *all* men, should know the Oilgear Story . . . how a steady stream of improvements both major and minor keep Oilgear Presses, Broaches, etc. at the head in these important production-tool fields.

Let us show you Oilgear's record of superiority in America's leading industrial plants. Write for further information. THE OILGEAR COMPANY, 1301 W. Bruce St., Milwaukee, Wis.

OILGEAR

BROACHING MACHINES AND PRESSES

Binks Pre-Cooler For Main Air Lines

A pre-cooler for use with the No. 540 main line oil and water extractor has been developed by Binks Mfg. Co., 3114-26 Carroll Ave., Chicago, Ill. This unit is said to increase the efficiency of the extractor in cleaning compressed air lines where excessive moisture is a problem. This unit will take care of 200 cu. ft. of air per min. and is arranged for connection to 2-in. pipe lines.

"Miccro" Supreme Sealing Compound

Developed to serve as a permanent seal for joints and seams on equipment using gases, oil or steam, the "Miccro Supreme" seal compound announced by the Michigan Chrome Co., 6340 E. Jefferson Ave., Detroit, Mich., possesses good adhesive qualities. It is elastic and will withstand severe vibration without cracking. The compound can be applied either with a brush or with the finger tips, and it sets quickly.

"Creatasoap" Solvent

A concentrated liquid grease and oil solvent offered as "Creatasoap" by Creative Chemical Co., Friendship Ave., Bloomfield P. O. Station, Pittsburgh, Pa., can be applied by hand or by spraying. It is odorless and will not harm the skin. A solution of one part of this material in ten to fifteen parts of water is claimed to be suitable for cleaning greasy surfaces on walls, floors, elevator shafts and machines. After application, it is washed off with water.

Strippit Announces Engineering Service

The Strippit Corp., 1559 Niagara St., Buffalo, N. Y., has announced an engineering service for users of "Wales" sheet metal punching and notching dies. Prints of new or changed parts are studied for applications of standard or special dies embodying the Wales principle. These dies may be used either in a power press or press brake.

Magnus "Clerex" Sludge Preventive

"Clerex" is a sludge dispersing agent developed by Magnus Chemical Co.,

Inc., Garwood, N. J. When added to fuel oil it is claimed to prevent the formation of sludge and gum, as well as to prevent rusting and pitting. The material is oil-soluble and can be used to clear existing sludge conditions as well as to prevent the formation of sludge. It is not injurious to metal tanks and piping or burner equipment and causes no difficulty in burning the fuel.

Fostoria "Mello-Beam" Lighting Diffuser

Glass fibers are banded together to provide a soft, pliable substance which accomplishes a combination of direct and diffused illumination in the "Mello-Beam" diffuser for "Localite" lighting units offered by The Fostoria Pressed Steel Corp., Fostoria, Ohio. Transmission factor of these diffusers is 55 per cent.

TRADE PUBLICATIONS

ALLOYS Constitution of the alloys of tin with bismuth is discussed in Technical Publication Series A, No. 77, issued by the International Tin Research and Development Council, 149 Broadway, New York, N. Y.

BENCH LATHES Rivett Lathe and Grinder Inc., 20 Riverview Rd., Boston, Mass., have issued several bulletins describing various types of bench lathes. Numbered 505 PB, 505 RB and 505 BB, they discuss respectively the plain bearing, roller bearing and ball bearing precision lathes.

BRAKE SHOES The friction of railway brake shoes at high speed and high pressure is discussed in University of Illinois Bulletin No. 72, published by the University at Urbana, Ill.

BUSHINGS Drill holder bushings for use on automatic screw machines are listed in a leaflet offered by the Banner Manufacturing Co., 1873 Clybourn Ave., Chicago, Ill.

COLLETS AND CHUCKS Bulletin No. 100-B, published by Rivett Lathe and Grinder Inc., 20 Riverview Rd., Boston, Mass., illustrates their complete line of draw-in collets and chucks.

CONTOUR SAW An illustrated booklet issued by Continental Machines, Inc., 1310 Washington Ave. S. Minneapolis, Minn., describes the "Do-All" contour machine for sawing, filing and polishing.

ENGRAVING The Ideal Commutator Dresser Co., 1057 Park Ave., Sycamore, Ill., has issued a folder describing several electric markers and etchers.

FIBER Specifications for "Armite" fiber are given in a data sheet published by Spaulding Fibre Co., Inc., 310 Wheeler St., Tonawanda, N. Y.

HEAT TREATMENT Thermal expansion and effects of heat treatments on the growth, density and structure of some heat-resisting alloys are discussed in Research Paper No. RP1106, published by the National Bureau of Standards, U. S. Department of Commerce. Copies can be obtained from the Superintendent of Documents, Washington, D. C. Price, 10 cents per copy.

JIG BORER Features of the No. 2A jig borer are discussed in Circular No. 412-1, published by Pratt & Whitney Div., Niles-Bement-Pond Co., Hartford, Conn.

LIGHTING The Fostoria Pressed Steel Corp., Fostoria, Ohio, has published a 24-page illustrated bulletin describing a complete line of localized lighting equipment.

3 JOBS
3 FIXTURES
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1* Broaching Machine

***Colonial Utility Broaching Press**

Above: Broaching external teeth on a synchronizer ring.

Center: Spiral broaching of oil grooves on guide bushings.

Below: Broaching roller bearing cages for Diesel trains.

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MICARTA Data Sheet No. 63-020 published by the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., tabulates data on the physical and electrical properties of Micarta.

PLANERS A reversing motor drive for planers is described in Bulletin No. 306 published by the Reliance Electric & Engineering Co., 1088 Ivanhoe Rd., Cleveland, Ohio.

ROTOMILLING A 20-page booklet describing the operation of the "Roto-Mill" has been published by the National Broach & Machine Co., 11457 Shoemaker St., Detroit, Mich.

SPRAY EQUIPMENT The Eclipse Air Brush Co., Inc., 390 Park Ave., Newark, N. J., describes a complete line of spray equipment in a 32-page illustrated catalog, No. 66.

TRANSMISSIONS The "Select-O-Speed" variable speed transmission is described in a folder published by the Ideal Commutator Dresser Co., 1057 Park Ave., Sycamore, Ill.

VIBRATION INSULATORS Catalog Section 7900 issued by B. F. Goodrich Co., Akron, Ohio, describes a standard line of "Vibro-Insulator" rubber-to-metal type mountings.

WIRE STRIPPER A line of wire and cable strippers is described in an illustrated folder now being mailed by Ideal Commutator Dresser Co., 1057 Park Ave., Sycamore, Ill.

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Low controls centralized 100% at the operating position are featured on the line of Super Service Radials shown at the left. All sizes, from the 4' machine with 13" diameter column to the powerful 12' arm machine having 26" diameter column, incorporate new improvements that will save money in your drill department.
High Speed 3' and 4' Super Service Radials will provide a speed range to suit your work no matter how small your drilling. All speeds and feeds changed by sliding gears with single lever control at the head. Balanced head and arm move on antifriction bearings for the ultimate in fast, easy handling.
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21", 24" and 28" Super-Service Uprights, round and box column types, set a new standard for convenience, stamina, accuracy and general production efficiency. One modern improvement is the elimination of all friction clutches. Be sure to get details of this new design.
The Cincinnati Bickford Tool Company
Oakley, Cincinnati, Ohio, U. S. A.

60 YEARS AGO

The following items appeared in *American Machinist* for October, 1878:

About Ourselves

With this issue the *American Machinist* becomes one year old. In this age of rash ventures, when newspapers go up like rockets and come down like sticks, it is a source of satisfaction to be able to chronicle the first year's successful progress. Last November, when we sent forth our first issue many of our friends shrugged their shoulders and spoke dubiously of its solid establishment. They essayed to point out to us what a weak foundation an independent machinery journal had to rest upon, and the necessity of starting up a patent-right bureau, a "machinery purchasing agency," a book selling department, or some other auxiliary to keep it alive. We firmly refused to depart from the principles laid down at the start, being fully determined that if we could not carry them out as proposed, that we would relinquish the whole business to someone that could. The result, however, has been very gratifying. Machinery manufacturers, being convinced of our sincerity in producing a candid, independent representative journal of the machinery interest, came to the support of the *American Machinist* with an energy that left us no doubt of the success of its mission. Subscriptions came pouring in from every state in our union and from many foreign countries.

Manufacturers

William Sellers & Co., of Philadelphia, have taken the bulk of the recent order from New South Wales for fine machine tools, amounting to some $25,000.

Questions and Answers

W.M.W., Peekskill, N. Y., writes for a bath or solution for tempering steel? A. Water, 1 gal.; spirits of nitre, 1 oz.; salamoniac, 1 oz.; white vitriol, 1 oz.; alum, 2 oz.; table salt, 8 oz.; saltpeter, 1 oz.; lard oil, 1 pint. Taps and dies should be heated to cherry red and drawn to light blue; wood tools drawn to copper color.

Give The Foreman Back His Job

L. A. APPLEY
Socony-Vacuum Oil Company

In recent years when things were not going so smoothly the foreman and his methods became the center of attack because of the importance of his position in industry. Special surveys were conducted, and in each case the center of the attack seemed to be the foreman or the supervisor, simply because he was in a position where all the activities of the company were coordinated for the workers and through him the workers received their final instructions.

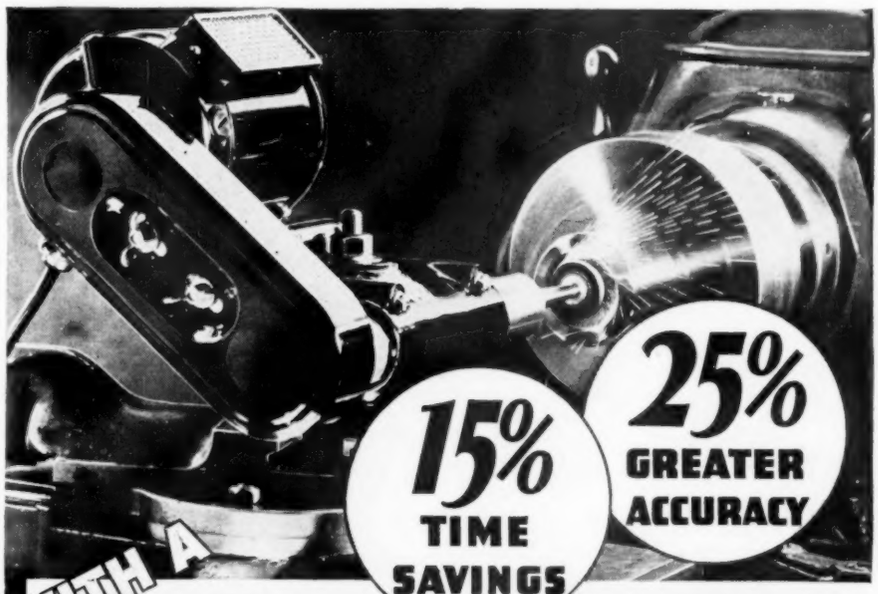
Unfortunately such specialization focused its attention on the individual activities for which the foreman was responsible. A magnifying glass was put on his methods of selection, his planning, his coordinating, his cost, his handling of materials, his stores, his direction of his people and so forth. Anyone of the specialists after such study could have performed the particular activity which he was studying better than the foreman, but the fact that the foreman had to do them all was often overlooked. The reaction, therefore, was that these things had to be done for the foreman, and one by one his functions were slowly taken away from him.

In other cases, attempts were made to improve the methods of the foreman. However, specialists who had spent months in the development of certain ideas attempted to explain them to the foreman in a half hour or half a day. Naturally, he could not receive as clear a conception of the matter as the specialist had. Since he did not have the opportunity or the same amount of time for consideration of the problem as the specialist the result ultimately was that the foreman was unable to adopt some of these improvements and, therefore, other people were set up to do it for him.

The result was that in many instances the foreman became nothing more or less than an inspector. He lost prestige, influence and authority. This is borne out by the fact that foremen in recent labor crises were looked upon as an insignificant part of the picture. The tendency has been to appoint special representatives for the workers for direct dealing with top management in spite of the fact that the foreman is the one who is in closest contact with them and should be their representative as well as the representative of the management.

Give the foreman back his job and define it clearly. A clear statement should be developed as to his obligations to his superiors, his associates on the same level and to his employees under him. He should know exactly what his functions and responsibilities are and what authority he has to go with them. This should then be reduced to writing.

In such an outline it should be made clear that the education and training of employees is the most important function for which the foreman is responsible. His primary function is to develop the people under him, to build them, to improve their performance by improving their attitudes, their skill, their habits and their knowledge. Educational programs for employees should be developed, directed and participated in by the foreman with the assistance of an individual or individuals who know the requirements, techniques and methods. A large amount of the training should be given directly by the foreman. In cases where he himself cannot give the information he should be acquainted with the proper sources for getting it and should invite any spe-



WITH A
DUMORE
PRECISION GRINDER

Good times or bad, there is always a place for tools that accomplish new savings in time and lower labor costs. Dumore *precision* Grinders go further than that. They increase accuracy and help you put out better finished products—quality that helps you keep the wheels turning even when times are tough. That's why there's little lag in Dumore sales during dull periods.

In the modern tool room or on the production line . . . wherever high speed grinding and finishing are required to tolerances as close as a tenth (.0001") . . "nothing does the trick quite like a Dumore", say owners of Dumore grinders. Ask any of the distributors in the list below to show you how Dumore makes savings. He will gladly give you a demonstration without obligation. Or write the factory for facts.

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MOLINE, ILL.—F. J. Normoyle Co.
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NASHVILLE—Buford Bros., Inc.
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NEW ORLEANS—Oliver H. Vanthorn Co., Inc.
NEW YORK—Morris Abrams Guarantee Specialty Co.
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ORLANDO, FLA.—Harry P. Leu, Inc.
PEORIA—Couch & Heyle, Inc.
PHILADELPHIA—Maddock & Co
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PITTSBURGH—Standard Machinist's Supply Co.
PORTLAND, ORE.—J. E. Haseltine & Co.
PROVIDENCE—Belcher & Loomis Hardware Co.
Reynolds Machinery
READING, PA.—Reading Machine & Tool Co.
RICHMOND—Smith-Courtney Co.
ROCHESTER, N. Y.—Erskine-Healy
ROCKFORD, ILL.—Mid-States Industrial Corp.
SAGINAW, MICH.—Reichle Supply Co.
ST. LOUIS—Calcord Wright Machinery & Supply Co.
SALT LAKE CITY—Salt Lake Hardware Co.
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cial people required to handle it.

These statements, of course, presuppose the ability of the foreman to do this teaching. This is a responsibility of his superiors. One of the primary requisites that a foreman should have is the knowledge and ability required and to a large extent it is possible to give him this knowledge and to develop his ability.

It is necessary that the foreman know something about the technique of education and training. One of his functions as a foreman is to determine the operations and activities required of his personnel for the accomplishment of the objective of the operation over which he is foreman.

Another activity of the foreman is to determine the performance condition that should prevail for every job over which he has supervision. In doing this he establishes an objective for the education and training of his employees because the establishment of standards of performance are things which he wishes to bring about through education and training, formal or informal.

Furthermore, the foreman must either continually, or at periodic intervals, analyze the performance of each employee as compared with the conditions that should prevail. This gives him a picture of the weaknesses that exist and of the progress to be made. This will show him very clearly the nature of the education and training that is required.

He should be fully aware of the ability of anyone of the four sources at his command to provide his employees with the type and quality of information desired. As has already been said, he should be able to give much of the information himself When this is not possible he should secure specialists of the company who can prepare subject material desired. Or, it may be necessary for him to bring someone in from outside the company or as a last resort to send the employee to some source outside of his department or even outside the company. Having determined the activities of all people under his supervision, having established performance conditions that should prevail in each case, having clear knowledge of individual performance as compared with these standards, knowing what help and information is required and being acquainted with available sources for supplying this help and information, it is then necessary for the foreman to set up a definite time schedule as to when this information and instruction is to be given and under what conditions.

* From a talk given at annual American Management Association Industrial Relations Conference, Chicago, February 15, 1938.

YOU'LL BE *proud* TO OWN THIS SET OF LUFKIN INSIDE MIKES

There's a lot of downright satisfaction in owning a set of Lufkin precision built Inside Micrometers. You can measure inside diameters down to 1½" or up to 40".

You'll like the balanced "feel" — they're the only Inside Micrometers that can be built up at both ends, keeping the head in the center.

Tubular steel rods, while light weight, give the tool, even when built out to extreme ends, the stiffness necessary for accuracy. They come in six sets — with range from 1½ to 8 inches up to 4 to 40 inches.

Ask your dealer to show you these Lufkin Inside Mikes or write to us for your free copy of Catalog No. 7.

NEW YORK 106 Lafayette St. THE LUFKIN RULE CO. SAGINAW, MICHIGAN Canadian Factory WINDSOR, ONT.

TAPES — RULES — PRECISION TOOLS

We Lose Money On That

JOHN R. GODFREY

Young Tom Johnson has a lot of the same kind of sense, horse or whatever, that has made his Dad such an interesting character. You might almost say an unusual person. The latest example was in the buying of a new special machine for the pistons of his engines. He'd been visiting automobile plants to see the latest methods.

"Selling quite a lot of these machines, I judge, Mr. Black," says Tom. "I've seen them in several plants lately as I went around."

"Yes, we have sold a lot of them. They've become standard equipment for holes that have to be right. They've saved a lot of money for the user—for everyone but us, to be exact."

"Just what does that mean, Black? I don't get it."

"Well, it's a fact, Johnson. We haven't made a dollar on this particular machine. If it wasn't for our other lines we'd be in a bad way."

"I've heard of 'loss leaders' in chain stores of various kinds, Black. But it sounds haywire to me especially in such a case as yours. What's your excuse? You aren't bragging about it, I hope."

"Too much special designing and special equipment with each machine, Johnson. This job of yours is fairly simple, but some of them take a lot of study and expensive fixtures."

"But why should you pay for that?"

"We'd have a hard time selling these machines if we charged what we should to make a fair profit."

"Then why build them at all? If this machine saves me what you say it will, and I believe it will, why sell it to me at a price that gives me a 100 per cent investment? I'm mighty glad to be able to charge its cost off in a year. But I wouldn't let anyone make 100 per cent on me unless I made a fair profit too."

"Other customers don't feel that way, Johnson. I wish they did. But we make it up on the other machines we build."

"That's a poor way to do business, Black, if you don't mind my being frank. That means you have to charge more than a fair price on your other line so you can sell this machine at a loss. I believe you can get enough for these machines to make it businesslike. If I couldn't, I'd quit making them."

"But they help to sell our other line, Johnson. We've tried to boost these prices enough to make a small profit, but the customers balk at the price. They don't realize what the fixture costs to design and build."

"Then it's time they did, Black. I'd charge a fair price for the machine and make a separate charge for designing and making the fixtures. If they don't want to pay it, let them make 'em themselves."

"They couldn't design or make fixtures to do the work we can, with our experience. But they sure beef about paying what they are worth."

"Why not make them two propositions? One a price that covers machine and fixtures and leaves a fair profit. The other a lower price, plus half the savings for a year. It's no credit to anyone to sell machines below a fair price. To me it means a lack of intestinal fortitude—and that is a disease every machine tool builder should be inoculated against."

These Machines We Build

ROGER C. DICKEY

A new machine is completed in the machine shop; it is placed into production and because it is new and fast a number of men or women lose their jobs. Three automatic safety pin machines threw 60 girls out of employment. Labor saving machines in the automotive field made it possible to eliminate 20,000 employees. Page after page of such cases could be listed.

Perhaps it is natural that labor should look on new machines as their enemy. Perhaps it is reasonable to expect newspaper editorials to criticize the labor saving machine.

But I should feel badly indeed if I thought that the industry that I earn my livelihood in should be the means of causing hardship to countless people, or that I was assisting in producing an article which would turn the wheels of progress in reverse. And I know from my intimate connection with machinists that they, too, are humanitarian enough to want to improve the condition of others rather than to be directly

TO GIVE PRECISION

Timken zero precision mirror finish roller bearings — dynamic balance of every rotating part — accurate gauging and inspection

TO KEEP PRECISION

Maximum slide areas — sturdy construction — three point bed mounting — perfection in material and workmanship

RIVETT LATHE & GRINDER INC.
BRIGHTON, BOSTON, MASS.
PIONEERS IN BENCH LATHE DEVELOPMENT

or indirectly responsible for the loss of jobs.

I believe that labor saving machines in every field of endeavor are the strides we take toward progress. These labor saving machines raise the masses to better lives and better living conditions. True, some people may be thrown out of work through their use, but this is a temporary problem and one that is rapidly being overcome. Their advantages far offset their disadvantages. Better articles at less cost are produced and new opportunities are created.

These machines we build must always be our slaves. We must never becomes slaves to them. And in every country where there is competition, the masses must profit by these machines. In the case of the safety pin machines, before the automatic machines were in use, the price of a card of safety pins containing a dozen, was ten cents. After the installation of the labor saving machines, the price was ten cents for a ring of fifty. Labor saving machines make it possible for countless thousands to enjoy the comforts of a new automobile and thus provide work for garages, gasoline stations, tire makers, road builders, etc.

As a general rule the workman is paid in direct proportion to what he can produce. With a modern machine he can produce more and better goods in less time. Statistics show that prior to the world war the worker produced $2343 worth of goods for which he was paid $743 per year. But last year he was able to produce $5133 worth of goods and he was paid $1345. Machines definitely raise wages.

These machines we build also shorten hours. It is within our remembrance when men worked ten hours a day for six days. The 60 hour week is gone now. The 50-hour week has gone. Agitation for a 30-hour week is at hand. Why? Because with the aid of labor saving devices we are able to turn out more work in less time. It is a step in readjustment; in completely submerging the machine as our servant.

If one considered the problem from every angle he could not blame machines for unemployment. Consider just three of the many thousands of machines that have been marketed in the past fifteen years: washing machines, radios and electric refrigerators. These three commonplace articles, machines in themselves, built on machine tools, have put thousands to work and have created unemployment for no one.

8 *out of* 18

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..... *use* OAKITE *Certified Cleaning*

*8 out of 18 manufacturers rated AAAA in Thomas' Register

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Among the more than 53 different Oakite materials produced, there is one or more that can help you establish wanted economies, just as they are doing for other leading manufacturers today. It is why we confidently say "It pays to change over to Oakite." Tell us your problem . . . let us, without obligation on your part, submit our recommendations.

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OAKITE *Certified* CLEANING

MATERIALS & METHODS FOR EVERY CLEANING REQUIREMENT

Malleable Iron Progress

Developments in the malleable casting art discussed at the recent annual convention of the American Foundrymen's Association include new materials and new annealing methods.

Three factors may be considered as primary causes for continued increase in the use of malleable casting. These are the development in the short cycle annealing methods, the increasing use of pearlitic malleables and the control of furnace atmospheres in the annealing of malleable iron castings.

Until recently, 60 or 70 hr. have been required to produce a full anneal, that is, a structure consisting of only ferrite and temper carbon. Today, iron of the conventional analysis, 1.00 per cent silicon and 2.50 per cent carbon, is being annealed in 30 hr. The electric furnace pointed the way to this reduction. It indicated that it was possible to drop the temperature in the period of no change in iron characteristics after the holding temperature.

Pearlitic malleable iron, in which either cementite or pearlite or both

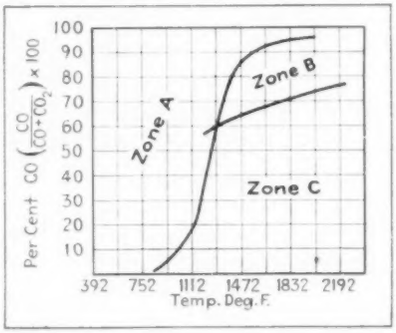
are retained, is being produced in cycles of approximately 6 hr.

W. P. McMillan, metallurgist, International Harvester Company in his paper before the A.F.A. 1938 convention discussed a malleable iron which can be annealed in 14 hr. and 28 min., the resulting structure reflecting the full anneal with retention of no cementite or pearlite.

The analysis of this short cycle iron should come within the following ranges: silicon, 1.60 to 1.90; carbon, 2.00 to 2.40; manganese, 0.25 to 0.35; phosphorus, less than 0.12; sulphur, less than 0.10. The sum of the carbon and silicon should be about 3.90 per cent.

The equipment used for annealing this iron is a gas-fired, radiant-tube, pusher-type furnace containing three rows of trays. There are 93 trays in the furnace, 31 on each rail. Trays weight 130 lb. and are 30 x 24 in., the 20 in. dimension being in the direction of travel. There is a clearance of 25 in. above the rail but the trays are seldom loaded more than 15 in. high. The load at each push is 1,200 lb., of which 800 lb. is net metal. At an interval of 28 min., the furnace will anneal 20 tons in 24 hr.

There are five zones in the furnace



The intensity of the reactions which directly affect annealing is determined by the distance from the lines dividing the three zones in the diagram: Zone *A*, temperatures above the critical point of the metal, tendency is to decarburize; Zone *B*, the tendency is to decarburize without, however, oxidizing the metal surface; Zone *C*, in addition to decarburization the metal surface is oxidized accompanied by scale formation

and five thermo-couples. The first three couples are connected with controlling and recording instruments. The fourth and fifth couples are connected with instruments which are recording only. The fourth couple is arranged so that control may be obtained if necessary.

The iron reaches a temperature of 1,700 F. in about 3 hr. and is held at that temperature for about 2½ hr. It is cooled to 1,475 F. in 2 hr. by air which is forced through tubes in the roof and floor of the furnace. It is cooled to 1,200 F. in about 6 hr. and further reduced in temperature in the fifth zone by cooling tubes to facilitate handling; the second fast cool period being about 1 hr.

Scale is prevented by the use of an atmosphere which is forced into the furnace maintaining a slight pressure. The atmosphere is produced from 800 B.t.u. gas by partial combustion and dehydration. The equipment has operated on less than 2 cu. ft. of 800 B.t.u. gas per net lb. of casting, including the gas required for the atmosphere.

The castings produced have a tensile strength of 50,000 lb. per sq. in. and an elongation of 10 per cent in 2 in. as a minimum. The yield point is definitely higher than the yield point of regular iron, tests having averaged about 43,600 lb. per sq. in.

It is believed that this material can be used in castings having other than relatively light sections. Tests indicate that, with proper degree of super-heat and with the composition within the desired range, this type of iron is clear in a 1 in. square section.

Some phases of atmosphere control in annealing of malleable castings were discussed in a paper by E. G.

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Ryerson Certified Steels offer you the maximum value for your steel dollar. They represent the highest quality obtainable in each classification. They are controlled by definite specifications based on the requirements of each particular type.

On the alloy steels, where results are dependent on heat treatment, Ryerson selects whole heats, analyzes and tests for heat treatment response, in order to secure higher quality and greater uniformity—then sends complete heat treatment data with every bar shipped. You know exactly what you are getting. This accurate data saves much costly testing and assures better results in less time. This added service is given without additional cost or obligation.

We will be glad to tell you more about Ryerson Certified Steel —which is, in truth, a bargain when uniform quality and dependable results are considered. Bulletin 10 provides complete information on the Ryerson Certified Steel Plan. The Ryerson Stock List gives descriptions, extras, sizes and lengths of all steel in stock.

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DeCoriolis, research director, and R. J. Cowan, chief metallurgist, Surface Combustion Corp.

Previous attempts to reduce the annealing time of blackheart malleable of specification grade usually resulted in the formation of a pearlitic rim. It is known that this condition was due to decarburization of the metal at some stage of its heat-treatment.

This problem may be solved by preventing or even by retarding the rate of decarburization during the first stage of annealing. If decarburization is prevented entirely, it will be found that temper carbon is present at the extreme outer edge which is desirable from the standpoint of machinability. Since this degree of excellence is not always necessary it is usually only to hold decarburization to an acceptable minimum.

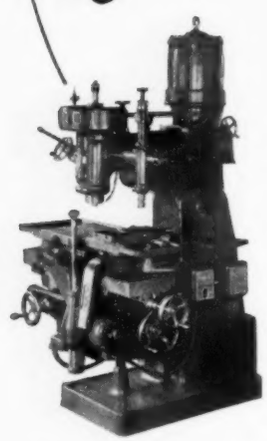
Studies indicated that decarburization occurs most rapidly during the first heating stages of the metal. Active decarburization was observed at temperatures below 1,300 F. in an atmosphere of the "DX" type. It was found that this continued during the heating to maximum temperature and also during the first holding stage. After graphitization had begun, however, and as its rate increased, decarburization became less and less a factor. It is very essential, therefore, that a carburizing atmosphere should not be used beyond the point where graphitization is going on very apidly. This point is usually considered to be within 2-3 hr. after the time maximum annealing temperature is reached.

As the essential thing is to secure the proper balance between CO and CO_2 either manufactured or natural fuel gas is a suitable source for such atmosphere. The gas is burned in an inclosed chamber with a controlled proportion of air which may be varied to yield a product as high as 12 per cent CO_2 and no CO to a product as low as 5 per cent CO_2 and 10 per cent CO. The hot products of combustion are passed through a water-cooled tower to remove excess moisture and are delivered to the furnace at controlled pressure.

In the intermittent type of radiant-tube furnace used in this work the iron castings are loaded into suitable alloy containers and charged into the furnace as a batch. After the doors are sealed and heat turned on, the first step is to purge all air from the furnace by means of a prepared gas which is non-combustible. As the castings approach the critical temperature, the combustion of the atmosphere is changed to reduce the CO_2 content. There also is added at this time a quantity of raw unburnt gas to raise the CO content of the mixture above that which it is possible to produce in the preparation unit and to lower the CO_2 in the atmosphere. It also produces a methane which is a strongly carburizing gas. This flow of raw gas is maintained up to the point of maximum temperature and for a short period thereafter. It is then turned off and the remainder of the annealing cycle, including the cooling period and second stage anneal is carried through by the use of prepared gas alone.

Operating in this manner it has been possible to prevent decarburization during the heating up and holding period and to prevent oxidation on scale formation during the remainder of the cycle. Temper carbon is found at the extreme edges of the casting with a complete absence of pearlite. The complete cycle in the intermittent furnace requires approximately 48 hr. The atmosphere can be modified to produce any desired results from a thin feather edge to a deep pearlitic rim.

There is no dividing partition or wall between the successive zones in the continuous furnaces used in this work. A compromise, therefore, must be established between the non-de-



The most intricate patterns can be reproduced faithfully on Gorton Duplicators to tolerances as close as practical for mold work (.001" and closer).

While working to achieve the utmost simplicity in their powerful Bulletin 709 Automatic Solenoid Starters, Allen-Bradley Co. also simplified their tool room work with Gorton Duplicators. The original molds for the 4-pole cross bars and thermal relay blocks above were cut to dimensions on the Duplicator with milling cutters. All duplicate and multiple cavity molds are produced with the duplicating attachments.

Mold costs have been so much reduced by Gortons that it pays now to have several identical molds on hand. This saves in molding operations and prevents any chance of holding up production of plastic parts for lack of molds to work with.

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carburizing atmosphere of the first stage and the non-oxidizing atmosphere of the second stage. The preference is toward slight decarburization during the first stage which is less injurious than recarburization during the second stage.

The volume of gas entering the furnace must be controlled very accurately. Too large a volume of gas or too lean a gas will bring about excessive decarburization and a consequent pearlitic rim. An intermediate flow of gas will not completely avoid decarburization as the furnaces are operated at present but will hold it at a satisfactory minimum which is much less than that encountered in the usual annealing practice. It has been found that too large a proportion of natural gas will produce an atmosphere too high in hydrogen for best results. An atmosphere of less than 12 per cent hydrogen seems to work best in a continuous furnace.

The fact that the continuous furnace is not as flexible as the intermittent type from the standpoint of atmosphere control is offset by its increased heating rate and by the fact that the furnace structure itself does not have to pass through a series of temperature gradients. Accordingly, the total time for annealing in a continuous furnace can be reduced to somewhere btween 30 and 36 hr. for the complete cycle.

A Study of Productive Capacity

The War Department has, it is stated, studied the productive activity of 20,000 individual plants with a view to their use in war time. To half of these specific tasks have here alloted, at least in theory. Selecting the job best suited to each shop requires judgment of the highest quality. To entirely prevent political influence, or favoratism, would be a modern miracle. But we can at least work toward that end.

Similarity of operations rather than of product should have first consideration. The pump or compressor departments of plants making household refrigerators, could make gages better than many plants that might seem nearer the gage line. The same is true of a plant making piston pins. In both cases the operators are used to working to "tenths" on their regular product.

Specialized plants whose product is applicable to peace or war, such as airplane instruments, should not be given other kinds of work. Instead they should be encouraged to plan to increase their capacity on short notice. An extra supply of tools and gages would be good insurance for rapid expansion of output when such an increase is necessary.

Forgings of many kinds play an important part in all war material. Forging dies can be made much more rapidly than before by the use of the multi-spindle die-sinking or engraving machines now available. All dies of this kind might well be in charge of a centralized department with branches in the different industrial centers where engraving machines of this kind are available.

With few exceptions, machine tool plants should not be diverted to the manufacture of munitions but should be kept for the making of the master tools of industry. Anything that will enable them to increase their output will, in most cases, be as important as the making of munitions themselves. While educational orders may enable them to retain their personnel in slack times, nothing should interfere with their ability to produce more machine tools when circumstances demand. For it must be remembered that, in peace or war, they are the backbone of the metal-working industry.

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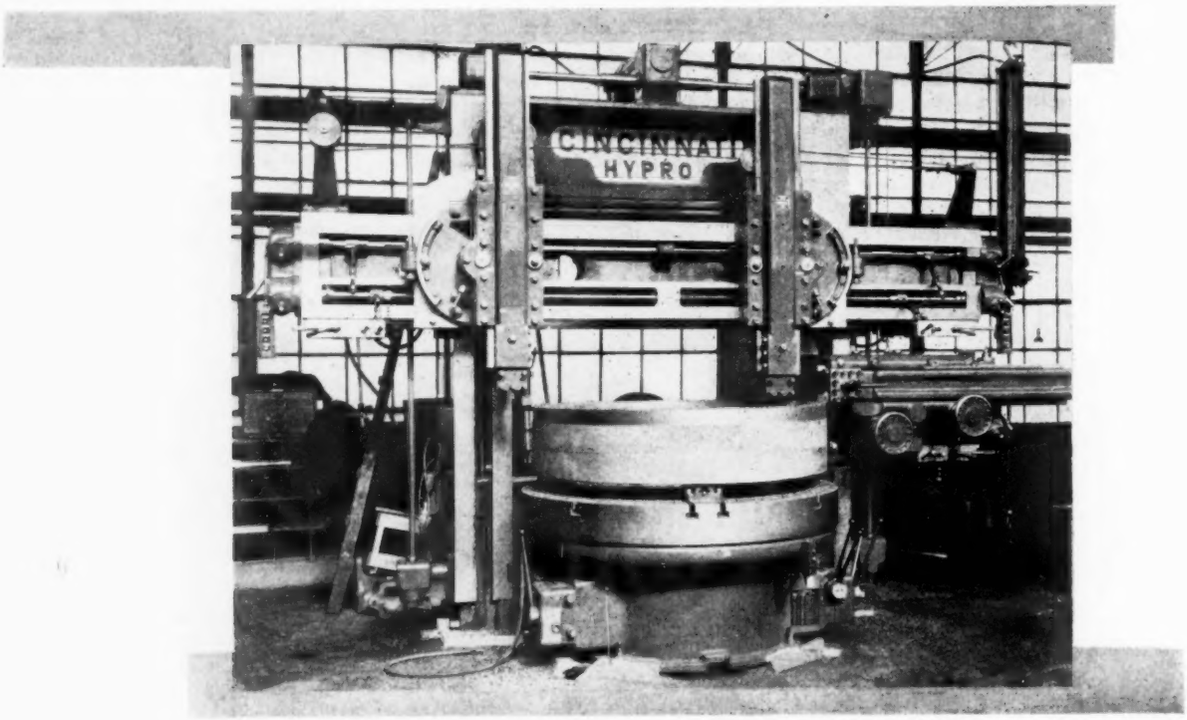

6' Cincinnati Hypro Vertical Boring Mill with side head, at the plant of Gardner-Denver Company, Quincy, Ill.

Small wonder they are "WELL PLEASED"

with the performance of their

CINCINNATI HYPRO BORING MILL

After all, cost-cutting performance counts these days. That's why Gardner-Denver Company, in reporting on the operation of their Cincinnati Hypro Vertical Boring Mill, write as follows:

"We are very well pleased with the performance of the machine. Have been able to better the time estimates on all operations furnished us by the Cincinnati Planer Company. Machining time has been reduced from 25 to 50 per cent over previous method. The rigid construction of the entire machine, especially the side head, makes it possible to get the results we have experienced."

Statements such as these are indicative of the production efficiency, accuracy and dependable service being obtained by users of Cincinnati Boring Mills and Planers everywhere. You, too, will find real satisfaction in the savings you can make with Cincinnati equipment. It will pay you to investigate.

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Cincinnati Hypro Openside Planers — 24" to 120"

Cincinnati Double Housing Planers — 24" to 120"

Cincinnati Vertical Boring Mills—4' to 12'

Cincinnati Planer Type Millers—30" to 120"

Detailed information available on request.

THE CINCINNATI PLANER COMPANY

Cincinnati, Ohio, U. S. A.